June 13, 1960

Aviation Week and Space Technology

SPECIAL REPORT:

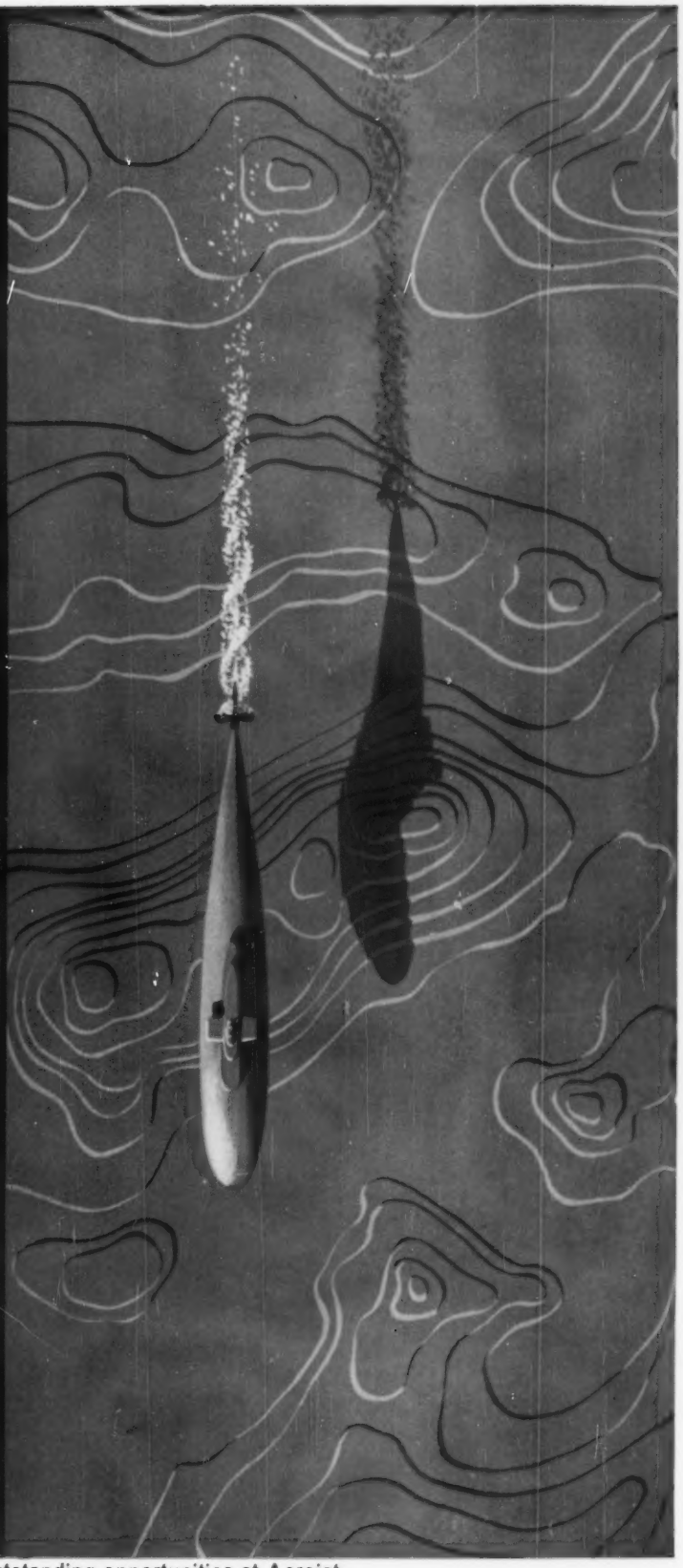
RF-101C Wing Photo Mission

Avco Mk. IV Re-Entry Tracked From C-54

AEROJET FOR UNDERWATER INTELLIGENCE

Our Atlantic Division at Frederick, Maryland, comprises an expert staff of mathematicians, electronic engineers, geophysicists and acousticians. Their specialty: research, development and production of underwater intelligence systems for anti-submarine warfare.

- DETECTION
- LOCALIZATION
- CLASSIFICATION
- IDENTIFICATION
- GUIDANCE
- COUNTERMEASURES



Aerojet-General
CORPORATION
Plants at Azusa, Downey, San Ramon and near Sacramento, California; Frederick, Maryland.
A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY

Engineers, scientists—investigate outstanding opportunities at Aerojet.

Solid State Components from Hydro-Aire may Solve Your Electronic Systems Problem

Today, Hydro-Aire offers you special skills in the development of solid state components to help you solve your systems problems. The Hydro-Aire Electronics Division has been created, staffed and tooled to provide flexibility in design, on-time delivery and reliable performance. These capabilities are now producing precise answers for project engineers at Martin, Boeing, Space Technology Laboratories, General Electric, Litton Industries, Magnavox, Autonetics, and many others.

For a prompt answer to your inquiry, write Electronics Division, Hydro-Aire, 3000 Winona Avenue, Burbank. A note on your letterhead brings your copy of our new Electronics Brochure.

Qualified Electronics Engineers are invited to investigate opportunities at Hydro-Aire by contacting Mr. Harold Giesecke.

HYDRO-AIRE

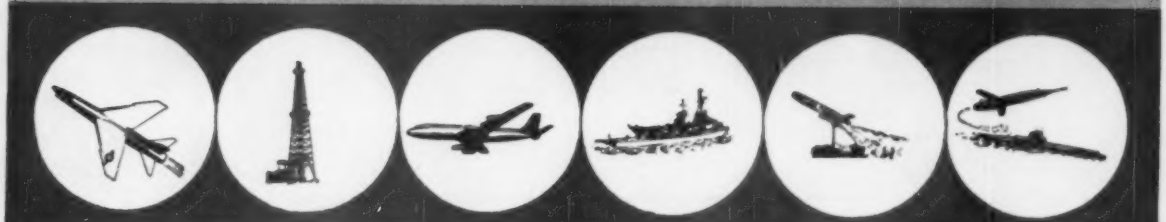
BURBANK, CALIFORNIA

Division of CRANE CO.

Solid-state devices include time delay devices, voltage regulators, power supplies, inverters.

SARGENT

SERVO-SYSTEMS OF FORCE CONTROL



With 38 years acceptance Sargent builds precision linear and rotary hydraulic, pneumatic, mechanical and electronic systems of force control to meet successfully the increasingly high requirements of marine, aircraft, missile, petroleum and industrial use. From original idea to finished product – SARGENT.

SARGENT FACILITIES

Manufacturing including –

- Research
- Design
- Development
- Testing
- Qualifying
- Machining & Grinding
- Heat Treating, all types
- Plating, all types
- Inspection
- Assembly

SARGENT BUILDS

- Servo-Systems
- Hydraulic Systems
- Integrated Packages
- Hydraulic Actuators
- Hydraulic Valves
- Hydraulic Pumps
- Hydraulic Motors
- Pneumatic Cylinders
- Pneumatic Valves
- Ball Screw Actuators
- Gear Actuators
- Gear Accessory Boxes
- Electronic Systems

Standard of Excellence

Sargent INTEGRITY BUILDS GOOD WILL

Since 1920

ENGINEERING CORPORATION

MAIN OFFICE & PLANT, 2533 E. FIFTY-SIXTH ST.
HUNTINGTON PARK, CALIF.

"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

June 19-24—Summer General Meeting, American Institute of Electrical Engineers, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 22-24—1960 Conference on Standards and Electronic Measurements, NBS Boulder Laboratories, Boulder, Colo. Co-sponsors: Institute of Radio Engineers' Professional Group on Instrumentation; Radio Standards Laboratory, National Bureau of Standards; American Institute of Electrical Engineers' Instrumentation Division.

June 23-25—16th Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.

June 26-July 1—63rd Annual Meeting and Apparatus Exhibit, American Society for Testing Materials, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 27-29—Fourth National Convention on Military Electronics, Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

June 28-July 1—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

July 3-4—Fourth Annual Fort Wayne National Championships (civilian, closed-course airplane races), Fort Wayne, Ind.

July 5-15—Special Summer Program in Inertial Guidance—Terrestrial and Interplanetary, Massachusetts Institute of Technology, Cambridge, Mass.

July 11-12—Conference on Response of Metals to High Velocity Deformation, Stanley Hotel, Estes Park, Colo. Sponsor: Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 28-29—Seventh Annual Symposium on

(Continued on page 6)

AVIATION WEEK and Space Technology

June 13, 1960

Vol. 72, No. 24

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Publication Offices, 99-129 North Broadway, Albany 1, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation; including missiles and space technology. Position and company connection must be indicated on subscription order.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $30 one year.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office. ©Copyright 1960 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK and SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Aviation Week and Space Technology, 330 West 42nd Street, New York 36, N. Y.

Engineering notes from the **SM/I REPORTER**

BY STANLEY M. INGERSOLL, *Capabilities Engineer*

Report No. 6

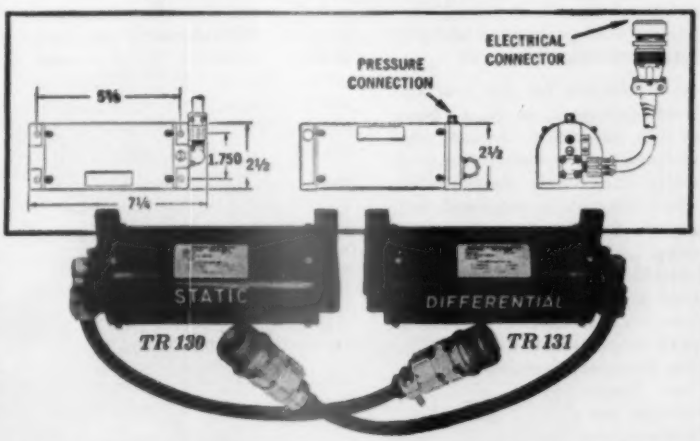
TR 130 Absolute Pressure Transducer and TR 131 Differential Pressure Transducer

These SM/I pressure transducers are precision built 400-cycle instruments using a cruciform cross-section helically twisted Bourdon tube with an electromagnetic pick-off to generate an electrical signal proportional to absolute pressure (TR 130) or differential pressure (TR 131) for use by computers and precision instrumentation. The design completely eliminates any mechanical friction or stiction and reduces hysteresis to an absolute minimum. The relation between output voltage and input pressure is linear.

They are particularly well adapted for use in aircraft because of high accuracy, low threshold, rugged, compact design and inherent repeatability of performance. The units have a mean time to failure of over 5,000 hours logged in in-flight operations. They meet the requirements of military specification MIL-E-5400.

Typical Performance Specifications

Scale Factor	0.0001487 volt/volt/mm Hg.
Applied pres. range	0 to 787 mm Hg. (absolute)
Damping (Restoration time)	0.1 second from full scale deflection to zero scale
Ambient temp. range	−65°F. to +175°F. (continuous duty)
Acceleration	Will withstand 30g without damage
Output voltage	0 volt to 3.50 volts for 30 volts of 400 cycles power applied and at load impedance of 20,000 ± 2% ohms
Frequency range	380 to 420 cps
Size	2½"x 2½"x 7¼"



For more information and complete operating specifications, write or wire SM/I today. Address your inquiry to Stanley M. Ingersoll, Capabilities Engineer.

SM/I SERVOMECHANISMS/INC.

Los Angeles Division
12500 Aviation Boulevard
Hawthorne, California

Latest high-temperature capacitor from AIRBORNE permits continuous duty at 700°F

STANDARD SIZES

PART No.	MFD	L	E	D	STYLE
E-8196-1M	.01	1.50	.625	625	A, B
-2M	.1	1.50	.875	.875	A, B, C
-3M	.25	.750	1.687	1.687	A, B, C
-4M	.5	1.625	1.437	2.00	A, B, C
-5M	1 0	1.625	2.125	2 125	A, B, C
-6M	2.0	1.625	2.750	2.750	A, B, C

Designed for integration with high-temperature aircraft/missile components, this newest addition to Airborne's line of miniaturized capacitors offers a working temperature range of –65 to +700°F—without voltage derating and with low capacitance variation.

As a dielectric for this new Airborne capacitor, we use a ribbon of thin, pure mica—because mica maintains its characteristics at temperatures well above 700°F. The conductor is aluminum foil, and the completed winding is encased in a stainless steel can for maximum corrosion resistance. A new copper spray technique has also been developed to provide high-temperature end connections. For terminals a special ceramic is used. These and other refinements provide the characteristics listed in the column opposite.

If you have requirements in high-temperature miniaturized capacitors, consult Airborne. Besides mica construction, we offer metallized Mylar* and Teflon† types—noted, as are all Airborne capacitors, for their electrical and mechanical reliability. Mylar is recommended to 300°F; Teflon to 400°F. Contact any of our offices or write for Product Bulletin PS-6A.

STANDARD CHARACTERISTICS—AIRBORNE HIGH-TEMPERATURE MICA CAPACITORS

Temperature: -65 to +700°F
Rated voltage: 300 VDC
Life: 250 hr. min. @ 340 VDC and 700°F
‡Capacitance tolerance: 10% Std.
Dissipation factor @ room temp.: 10,000 megohm/mfd @ 25°C

*Du Pont's TM for its polyester film
†Du Pont's TM for its tetrafluoroethylene resins
‡Closer tolerances on special order

AIRBORNE

Engineered Equipment for Aircraft and Industry

AIRBORNE ACCESSORIES CORPORATION

HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas

AVIATION CALENDAR

(Continued from page 5)

Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 1-3—"Future of Manned Military Aircraft" (Classified Meeting), Institute of the Aeronautical Sciences, El Cortez Hotel, San Diego, Calif.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 18-19—Second International Symposium on Submarine and Space Medicine, Laboratory of Aviation and Naval Medicine, Karolinska Institute, Stockholm.

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado, Boulder, Colo.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 27-30—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif. Cosponsors: USAF; U.S. Army; U.S. Navy; National Aeronautics and Space Administration; Atomic Energy Commission.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

At The Ramo-Wooldridge Laboratories... integrated programs of research & development of electronic systems and components.

The new Ramo-Wooldridge Laboratories in Canoga Park provide an environment for creative work in an academic setting. Here, scientists and engineers seek solutions to the technological problems of today. The Ramo-Wooldridge research and development philosophy places major emphasis on the imaginative contributions of the members of the technical staff. ■ There are outstanding opportunities for scientists and engineers. *Write* Dr. Richard C. Potter, Head, Technical Staff Development, Department 10-F.

THE RAMO-WOOLDRIDGE LABORATORIES

A DIVISION OF THOMPSON RAMO WOOLDRIDGE INC.
8433 FALLBROOK AVENUE, CANOGA PARK, CALIFORNIA

An electron device permits scientists to study the behavior of charged dust particles held in suspension.

XVIII ABN. CORPS

4TH INF. DIV.

82ND ABN. DIV.

101ST ABN. DIV.

BELL "IROQUOIS" JOINS FAMED STRAC DIVISIONS*

*The turbine-powered "Iroquois" offers commanders and field forces bold new tactical advantages. Assault divisions, their missile, medical-, and signal-support units have received production-line HU-1A's in quantity.

FEATURES OF BELL **HU-1A**.. PROVED IN THE FIELD BY **STRAC**

- ***Air Transportability*** – *loading and movement operations in C-124, C-130 and C-133 aircraft.*
- ***Tactical Troop-Lift Tests*** – *up to nine fully-equipped men.*
- ***External Cargo Carry*** – *up to 2,700 pounds (standard Army jeep).*
- ***Medical Evacuation*** – *including actual emergencies, day and night.*
- ***Air-Mobile Command Post*** – *places commander at the point of decision.*
- ***Minimum Helicopter Maintenance*** – *high availability, proved in testing, upheld in field.*

For operational turbine-powered firsts, look to **BELL** HELICOPTER CORP.

Fort Worth, Texas Subsidiary of Bell Aircraft Corporation..in its 25th year

W. M. Willis, Chief Engineer of Marman Division, displays some of the many couplings and joints developed by Marman engineers.

MARMAN

Leads in Joint and Coupling Engineering

Pictured at the left are a few of the many V-Band Couplings and Joints designed and produced by Marman for every aircraft and missile application. Marman V-Band Couplings are ideal for connecting all sizes of tubing, piping and ducting used in fluid transfer and structural applications. The lightweight Marman J13 V-Band Joint provides efficient sealing for pneumatic and hot air or gas lines. The J11 V-Band Joint may be used for fluid systems. Marman high-performance CONOSEAL Joints provide a leakproof seal where zero leakage is required over a wide temperature range.

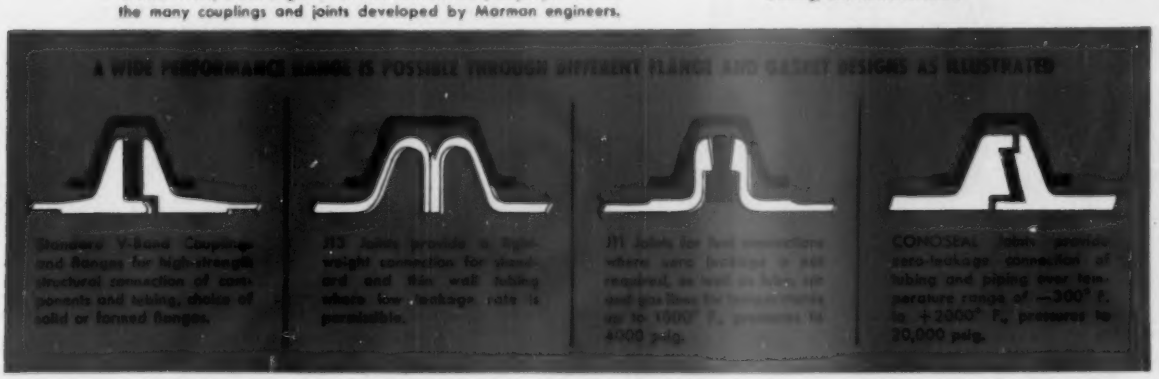
Call on Marman's 20 years of experience when you have a joint or coupling problem. Highly skilled and experienced engineers are ready to be of assistance to you. Also send for the new Marman Catalog No. 800 showing hundreds of joints available from stock.

CONOSEAL is an Aeroquip Trademark

Aeroquip
MARMAN DIVISION

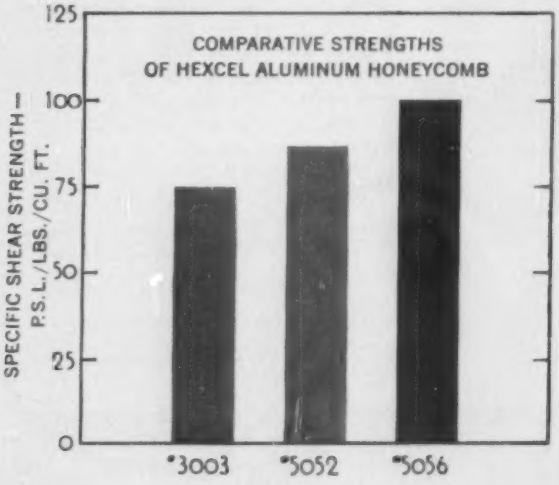
11214 Exposition Blvd., Los Angeles 64, California

Joints, V-Band Couplings and Flanges, Fuel and Hot Air Couplings, Band Clamps, Instrument Clamps, Bellows, Ducting, and Universal Joints.

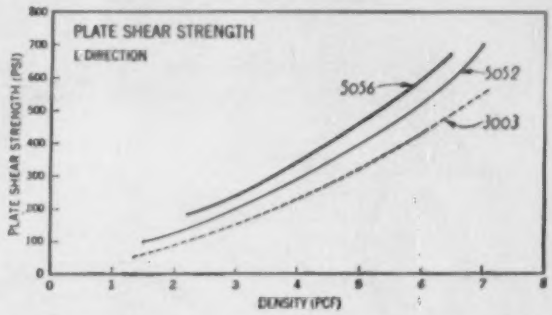

A WIDE PERFORMANCE RANGE IS POSSIBLE THROUGH DIFFERENT FLANGE AND GASKET DESIGNS AS ILLUSTRATED
Standard V-Band Couplings and Flanges for high-strength structural connection of components and tubing, choice of solid or formed flanges.
J13 Joints provide a lightweight connection for pneumatic and thin wall tubing where low leakage rate is permissible.
J11 Joints for fluid connections where zero leakage is not required, as used on hot air and gas lines for temperatures up to 1000° F., pressures to 4000 psig.
CONOSEAL joint provides zero-leakage connection of tubing and piping over temperature range of −300° F. to +2000° F., pressures to 20,000 psig.

20% More Strength...
20% Less Weight
Permit New Applications of HEXCEL Honeycomb

Hexcel meets the critical need of today's jet aircraft and missiles for stronger aluminum honeycomb with new 5056 alloy, conservatively 20% stronger than any existing aluminum core of the same weight. This important development by Hexcel not only makes possible further reduction in weight of existing honeycomb applications, but offers opportunities for a wide range of new design applications where the additional strength of 5056 is essential.



Hexcel 5056 honeycomb is the result of four years' research and study of more than 100 materials, including 10 aluminum alloys, and represents the first major improvement in aluminum honeycomb since 1954, when Hexcel introduced its 5052 alloy honeycomb to the industry. 5056 alloy contains the same metals as Hexcel's 5052 and 3003, with a significant increase in magnesium content. Current tests indicate that 5056 has very nearly the highest strength-to-weight ratio of any aluminum honeycomb ever made, but without the corrosion problems usually associated with high-strength aluminum alloys. New 5056 honeycomb offers an immediate solution to design problems of weight and strength in the aircraft and missile fields, as well as applications in electronics, construction, lighting and packaging.



In comparison with 5052 alloy, 5056 shows an improvement in bare compressive properties of approximately 25% which is 250% of specification minimums. Shear strengths are at least 20% above 5052 and 50 to 100% above specification minimums. 5056 cell sizes are ⅛" to ⅜"; foil gauges .001" and .002". For detailed test results and complete data on Hexcel's 5056 honeycomb, write Dept. 6-E.

HEXCEL® PRODUCTS INC.

World's Largest Manufacturer of Honeycomb Products and Materials

Executive Offices: 2332 Fourth St., Berkeley, California
Distribution Throughout the United States and Canada

6288

A Tracking Center collects, evaluates and displays pertinent information on all air activities within its area of responsibility. Each tracking site can track while scanning many high speed maneuvering targets. Position information and supplementary intelligence is available for insertion into the system from the communications network which involves all stations in the system.

The Control Function results in accomplishment of tactical air missions assigned by the command center, including intercepting air targets, air attacks on ground targets, return-to-base missions and response to emergency situations. The vectoring computer group calculates optimum intercept vectors, and guides the assigned aircraft to the target, constantly correcting for target maneuvers and drift. One air controller can monitor many air missions, providing a greatly expanded capacity over manual systems.

Communication is accomplished in ground-to-air messages by automatic voice or digital techniques. Microwaves, tropospheric scatter or land line communication is used between sites. Compact message structure and efficiently programmed time-sharing insures rapid updating of a maximum number of targets. Communication facilities are flexible and can easily be reorganized to accommodate a change in the number of sites.

From the **REMINGTON RAND UNIVAC**

Military Division

TACS—*combining data processing, communications and control functions—demonstrates total systems capabilities.*

A significant example of the capabilities of the Remington Rand Univac Military Division is the AN/TSQ-13 Tactical Air Control System. This USAF System automatically performs air surveillance, evaluation and control functions in a 160,000 square mile area, reassessing the air situation every 30 seconds to facilitate command decisions.

The transportability of the System allows Control and Reporting Centers to be quickly moved into far forward positions to give surveillance of tactical territory. A communications network, involving both voice and digital techniques, coordinates these functions with weapon groups and other military activities to successfully meet the fast-changing needs of the tactical air situation.

Designed and built by the Military Division, the Tactical Air Control System fully integrates the computation, communication and control functions. The System represents a solution to a complex problem and exhibits the characteristics which have become identified with Remington Rand Univac achievements in the military area—compact size, high speed of operation and reliability under demanding environmental conditions.

UNIVAC®

Remington Rand

UNIVAC

DIVISION OF SPERRY RAND CORPORATION

Univac Park, St. Paul 16, Minnesota

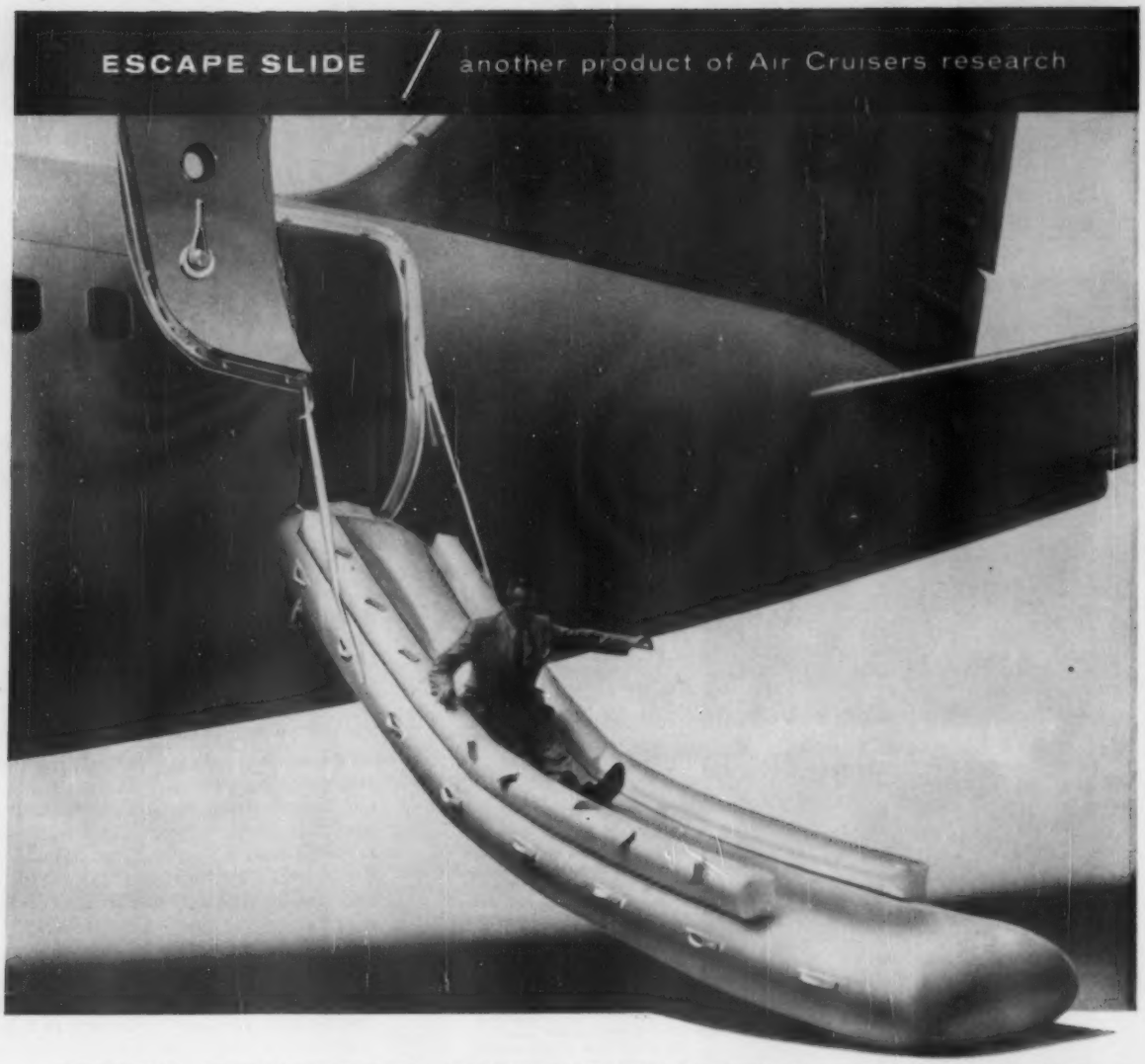
Other control and data systems developed by the Remington Rand Univac Military Division include:

ATHENA, the Ground Guidance Computer for the U.S. Air Force ICBM TITAN.

BOMARC Computer for the U. S. Air Force Target Intercept Program.

SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY
AN/USQ-20 (Advanced Computer for the U. S. Navy).

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.



NEW ESCAPE SLIDE SAFETY FEATURE

This flexible escape slide developed by Air Cruisers for jet airliners provides rapid and safer emergency evacuation of passenger aircraft, particularly at extreme aircraft attitudes.

The passenger's speed of descent is automatically reduced by his own body weight bending the last portion of the flexible slide closer and closer to a horizontal attitude as he nears the ground. Rate of descent is virtually stopped as the passenger eases off the final few feet of slide resting parallel on the ground.

Simple to operate, Air Cruisers escape slides are standard equipment on many turbine-powered military and commercial aircraft.

The Air Cruisers jet pump, which produces rapid inflation vital to the fast, dependable operation of escape slides, is yet another contribution toward better survival equipment by America's most experienced fabricator of inflatables from rubberized nylon materials.

Your inquiries are invited.

THE GARRETT CORPORATION

AIR CRUISERS DIVISION

BELMAR, NEW JERSEY

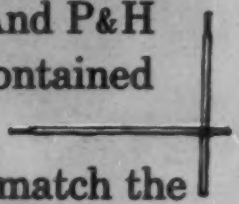
LIFE JACKETS • LIFE RAFTS • HELICOPTER FLOATS • ESCAPE SLIDES • GAS BREATHER BAGS • DECELERATION BAGS

If profitable arc-welding is important to you, then you ought to investigate the complete line of modern Harnischfeger

equipment. For example, P&H weld-programming with motorized rheostat or sequence-timers enables you to weld Space Age and other super-critical metal automatically! Or you can automate your welding

with P&H punched-tape control. Both are infinitely versatile and standardize weld quality at levels

impossible with manual controls. P&H also offers you industry's most complete line of industrial welders — 1 to 750 amps. — AC, DC, or dual AC/DC machines with h-f, spot gun, and gas and water controls. And P&H engine-driven welders give you compact, self-contained 25- to 500-amp. weld-power for field jobs. The



different types of P&H electrodes enable you to match the

analysis and properties of many weldable parent metals. And you can cut welding labor and overhead costs in half with P&H welding positioners. So...

WELD MODERN WITH P&H EQUIPMENT

Literature available on all products.

Export Division:
4329 W. National Ave., Milwaukee, Wis.
P&H welding equipment is manufactured and sold in Canada by REGENT EQUIPMENT MANUFACTURING CO., LTD.
466 King St. West • Toronto, Ontario, Canada.

310

P&H HARNISCHFEGER
WELDERS • ELECTRODES • POSITIONERS
MILWAUKEE 46, WISCONSIN

A3J—*the most versatile Mach 2 airplane in the world today*

Probing the horizons of the Free World, hovering on the fringes of tension areas, bolstering the cause of world peace by its mere presence in the sky—this is the job for the Navy's new A3J Vigilante.

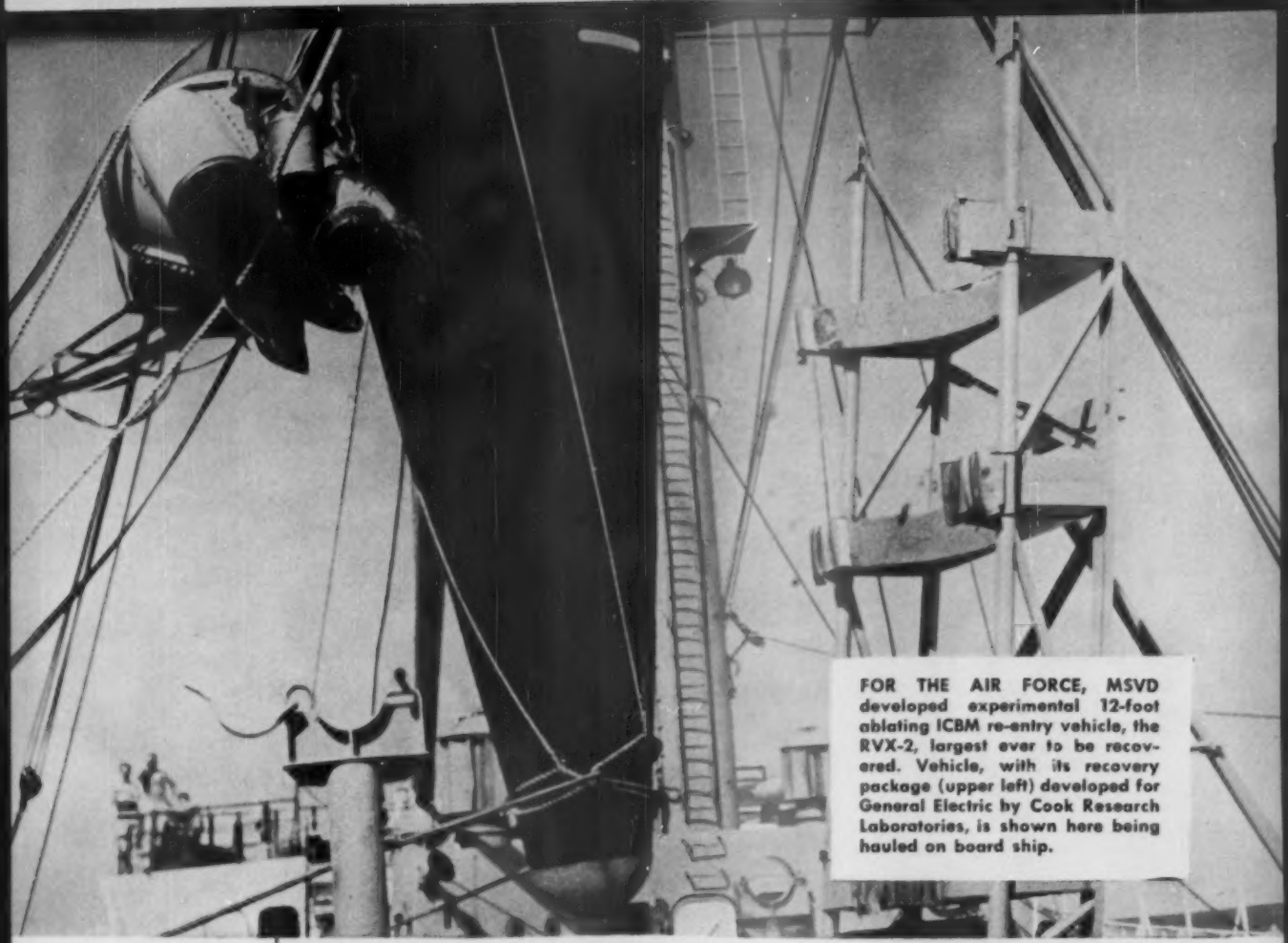
Designed and built by the Columbus Division of North American Aviation, the A3J has a versatility unmatched by any other Mach 2 airplane in the skies today. It is equipped to handle a variety of nuclear or conventional weapons for either limited or all-out nuclear war. It has the speed and maneuverability to fly single-plane attack missions without fighter escort.

The Vigilante can fly through the stratosphere faster than the earth turns beneath it; yet can throttle down to comfortable landing speeds for carrier decks—or small fields ashore. It is also notable for prompt response characteristics that make it ideally suited for low-level missions over irregular terrain. Its speed and maneuverability plus the most advanced fire control systems known make it a single airplane with an outstanding dual capability—high-performance attack or long-range interception.

The A3J Vigilante truly is a significant addition to the U. S. arsenal dedicated to preserving world peace.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio



FOR THE AIR FORCE, MSVD developed experimental 12-foot ablating ICBM re-entry vehicle, the RVX-2, largest ever to be recovered. Vehicle, with its recovery package (upper left) developed for General Electric by Cook Research Laboratories, is shown here being hauled on board ship.

MISSILE AND SPACE VEHICLE DEPARTMENT

...center for missile and space technology research and development at General Electric

Progress in search and recovery

With each recovery of a space vehicle, scientists gain important new knowledge about the environment of space and its potential effect on man and the operation of vehicles and equipment. As more advanced vehicles are developed for space flight—some with life aboard—successful location and recovery become increasingly vital.

General Electric's Missile and Space Vehicle Department pioneered in the development of space vehicle search and recovery techniques as part of its re-entry and recovery vehicle program for the U.S. Air Force. MSVD developed and built the first payload to be recovered from space—an 18-inch data capsule ejected from an Air Force Thor re-entry vehicle on June 13, 1958. Many such data capsules have since been recovered from both Thor and Atlas flights—some carried cameras providing films from space. MSVD also developed and built the 12-foot long, one-ton re-entry vehicle shown above which the Air Force recovered on July 21, 1959—the largest to be returned to date. Today, as MSVD builds and flight tests more complex vehicles, it is continually expanding and improving its already successful search and recovery program.

Currently, this search and recovery experience is being applied to the development of such important space programs as the Air Force "Discoverer" recovery satellites and NASA's radiation research recovery vehicles (NERV).

For more information about MSVD's work in search and recovery, write to Section 160-79, General Electric Co., Missile and Space Vehicle Department, Philadelphia 4, Penna.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT

A Department of the Defense Electronics Division

Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. T. H. Sebring, Dept. 160, MSVD

NEW MICRO-DIFFERENTIAL PRESSURE METER

*A NEW INSTRUMENT BASED ON THE PATENTED DECKER T-42 IONIZATION TRANSDUCER

Now you can measure differential pressures from $\pm 0.0003"$ H_2O to $\pm 100"$ H_2O with a single sensitive and economical pressure meter. Differential pressure can be read directly from the new Decker Model 306-2 Meter, or the 10 Vdc full scale analog output can be fed to external displays, recorders, or control devices.

The entire range of pressures is covered with just six interchangeable Series 306 Sensors. Each contains a precision, corrosion-proof two chamber capsule. Any diaphragm motion is sensed by a capacitance pick-up that exerts negligible coercive force on the diaphragm. Minute capacitance changes are converted by the T-42* Ionization Transducer to large analog output voltages indicating direction as well as magnitude. The instrument is capable of 0.05% resolution.

Given a suitable vacuum reference level, you can use the 306-2 to take vacuum measurements down to 2 microns. Equipped with a pitot static tube or orifice, the unit will measure gas flow velocities as low as 9 in./sec. And the 306-2 has proved itself ideal for measuring small physiological pressures, as in digital plethysmography.

Complete details on the meter are in Data Sheet 306-2. The Sensors are covered in Data Sheet Series 306. Write The Decker Corporation, Bala Cynwyd, Pennsylvania.

THE DECKER CORPORATION *Bala Cynwyd, Pennsylvania*

The challenge of silence

The wide and deep sea is a near-perfect hiding place . . . and an infinitely mobile missile launching pad. This makes anti-submarine warfare a high-priority defense problem.

Not just the sea, but the surface and the air as well, comprise the theatre of ASW. And in all these areas, Sperry is making advanced contributions: submarine sonar detection gear . . . submarine fire control systems . . . submarine depth and maneuvering controls . . . countermeasures and counter-countermeasures . . . sophisticated navigational computers for helicopters, capable of programming a systematically precise sub search . . . automatic flight controls for the helicopter to permit it to do its job despite the vagaries of weather or mission complexity . . . for surface ships, precision torpedo fire control and hydrofoil stabilization and control systems.

Most of today's ASW programs utilize sound radiation techniques. But being explored are myriad "unsound" techniques of sea-hunting, vast new frontier for scientist and engineer . . . investigations in the electro-magnetic spectrum . . . development of advanced transducers, data processors, and means of displaying data that is gathered.

These anti-submarine warfare programs, ranging through the three dimensions of our environment, typify the *integrated* capability of the Sperry organization today. General offices, Great Neck, N. Y.

SEA · SURFACE · AIR · AEROSPACE

SPERRY

OPERATIONAL under two flags...

THOR DETERS AGGRESSION

Now rolling from assembly lines in the U.S.A. and being deployed by our ally, Great Britain, is the aggressor deterring, nuclear armed THOR missile. Exceptional reliability has been achieved in this IRBM missile through simplicity of design and dependability of components.

Vickers pumps were selected for the vital hydraulic system on the THOR because of their proven reliability record, based upon millions of flight hours in military and commercial aircraft. Vickers-built components or complete auxiliary power systems are aboard nearly every missile built in America.

For the future, Vickers is working side by side with contractors, such as Douglas on new and revolutionary APU concepts for missiles and spacecraft of the next generation.

Your nearby Application Engineer can "fill you in" on the latest and most promising of these Vickers developments. Write for Bulletin A-5233A

Vickers Main System Hydraulic Pump being installed on THOR

AERO HYDRAULICS DIVISION

VICKERS INCORPORATED

TORRANCE, CALIFORNIA · DETROIT 32, MICHIGAN

A DIVISION OF

SPERRY RAND CORPORATION

8486

June 13, 1960

Aviation Week and Space Technology

Vol. 72, No. 24
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 Los Angeles 17—1125 West Sixth St., Phone: HUntley 2-5450 Dallas 1—1712 Commerce St., Phone: Riverside 7-5117 European Office—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

Senate Group Increases B-70 Budget 26
▶ $285 million voted to boost Mach 3 bomber program; extra funds approved by House for air alert eliminated.

Capacity Issue Deadlocks Bilateral Talks 38
▶ Pressure for international traffic sharing grows; U. S. aviation foreign policy changes could result.

Ground, Air Planning Speed RF-101C Photo Flights . . 54
▶ McDonnell fighters of USAF's 66th Tactical Reconnaissance Wing scramble in 12 min. on training missions in Germany.

SPACE TECHNOLOGY

USAF Awards Solar Power Study 27
Solid Propellant Rocket Techniques . . 28
Space Research Policy Criticized 32
Space Surgeon Course Set Up 34
Reflectors Cut Solar Power Unit Weight 79
Schlieren System for Mercury Tests . . 83
Orbital Space Laboratory 85

MISSILE ENGINEERING

Canadian Bomarc Funds 26
Titan Launches Mk.3 Nose Cone 103

AERONAUTICAL ENGINEERING

RF-101C Photo Missions 54
BMW Jet Develops 79 lb. Thrust 75
Northrop Automates Brazing 76
Production Briefing 77
Helicopter Shows Midair Recovery . . . 104

AVIONICS

USAF Widens Reliability Test Use 87
Filter Center 95
New Avionic Products 99

BUSINESS FLYING

Bellanca 260 Pilot Report 112
Tailless Glider Has Engine 121
Private Lines 122
Business & Utility Aircraft Shipments . 124

AIR TRANSPORT

Bilateral Talks Deadlocked 38
Soviets Reveal An-24 Configuration . . 39
Capitol Management Struggle 40
Transport 'Hook' Landings 41
FAA-Pilot Inspection Dispute 43
Helicopter Financial Reports 43
Surface-Mail-by-Air Attacked 45
TWA Scores Jet Parts Pricing 47
Shortlines 49
Airline Observer 49
Airline Income & Expenses 52

MANAGEMENT

Senate Group Increases B-70 Budget . . 26
Conflict-of-Interest Bill 30
New Curtiss-Wright Management 30
Unions Strike Convair, UAC 31
USAF Basic Research Threatened 33
Aerospace Corp. to Replace STL 34
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 37

EQUIPMENT

Altimeter System Corrects Error 105
What's New 109

Calendar 5
Letters 134

EDITORIAL

Two Positive Programs 21

COVER: Avco Mark IV nose cone re-enters the atmosphere near Ascension Island, 5,000 mi. down the Atlantic Missile Range, after flight on a USAF-Martin Titan intercontinental missile on Mar. 22. Re-entry is being tracked by high speed motion picture camera from a USAF C-54 aircraft. Mark IV cone is scheduled for Titan and some Atlas squadrons. Photo was made by opening shutter of 35 mm. camera to record re-entry trajectory in a time exposure, then using flashbulb to record interior of plane.

PICTURE CREDITS

Cover—Jack Philo of Avco; 27—Lockheed; 28, 29—United Technology Corp.; 37—Fiat; 41, 104—All American; 48—British West Indian Airways; 54, 55, 57—D. A. Anderton; 61, 64 (top)—General Electric; 64 (bottom)—Continental Aviation & Engineering Corp.; 73—Republic Aviation; 75—BMW Triebwerkbau GmbH; 76—Northrop; 83—McDonnell Aircraft Co.; 85—Chance Vought Aircraft; 79, 89, 103—USAF; 105, 108—Garrett Corp.; 112, 113, 114, 119, 120 (top)—Downer Aircraft Industries, Inc.; 119 (bottom)—Champion Aircraft Corp.; 121 (top)—Bolkow, (bottom)—Hughes Tool Co.

PUBLISHER . . . . . Robert W. Martin, Jr.
EDITOR . . . . . Robert B. Hotz

MANAGING EDITOR . . . . . William Gregory
EUROPEAN EDITOR . . . . . David A. Anderton
WASHINGTON . . . . . Cecil Brownlow
NEW YORK . . . . . Harry Raven, Herbert J. Coleman, John A. Hemmeck
LOS ANGELES . . . . . Irving Stone, Richard Sweeney, Russell Hawkes, William S. Read
DALLAS . . . . . Erwin J. Bulban
ENGINEERING . . . . . Robert I. Stanfield, J. S. Butz, Jr., Michael Yaffee
AVIONICS . . . . . Philip J. Klass, Barry Miller
CONGRESS . . . . . Ford Eastman, Katherine Johnsen
SPACE TECHNOLOGY . . . . . Evert Clark, Craig Lewis
TRANSPORT . . . . . L. L. Doty, Glenn Garrison, Robert H. Cook, David H. Hoffman
MILITARY . . . . . Edward H. Kolcum
EQUIPMENT . . . . . Barry Tully
BUSINESS FLYING . . . . . Erwin J. Bulban
ART EDITOR . . . . . Lawrence J. Herb
ASST. ART EDITOR . . . . . Karl G. Neuman
SPECIAL PROJECTS . . . . . Andrew A. Keil
EDITORIAL PRODUCTION . . . . Arnold Sherman
ASSISTANT EDITORS . . . . . Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS . . . . . Marjorie Nail, Jerome Bailey, Marjorie Todd
LIBRARIAN . . . . . Theresa V. Maggio

FOREIGN NEWS SERVICE

EDITOR . . . . . John Wilhelm
LONDON . . . . . John Tunstall
PARIS . . . . . Robert E. Farrell
BONN . . . . . Marrie Helitzer
MEXICO CITY . . . . . Peter Weaver
TOKYO . . . . . Sol Sanders

DOMESTIC NEWS BUREAUS

ATLANTA 3 . . . . . 1301 Rhodes-Haverty Bldg.
CHICAGO 11 . . . . . 520 No. Michigan Ave.
CLEVELAND 15 . . . . . 1510 Hanna Bldg.
DETROIT 26 . . . . . 856 Penobscot Bldg.
HOUSTON 25 . . . . . W-724 Prudential Bldg.
SAN FRANCISCO 4 . . . . . 68 Post St.

SALES

ADVERTISING SALES MANAGER . . . . . E. P. Blanchard, Jr.
ATLANTA . . . . . R. H. Powell
BOSTON . . . . . A. C. Boughton
CHICAGO and ST. LOUIS . . . . . J. S. Costello, D. C. Jackman
CLEVELAND . . . . . T. H. Hunter, Jr.
DALLAS . . . . . R. T. Wood
DENVER . . . . . John G. Patten
DETROIT . . . . . R. R. Butera
LOS ANGELES . . . . . C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK . . . . . M. J. Storz, J. M. Grinton, R. Wallace, J. D. Warth
PHILADELPHIA . . . . . J. D. Willis, W. L. Blanchard
PITTSBURGH . . . . . H. P. Johnson
SAN FRANCISCO . . . . . William Woolston
PROMOTION & RESEARCH MGR. . . . . C. C. Gersna
EUROPEAN MARKETING DIRECTOR . . . . . Fulvio Piovano
RESEARCH & MARKETING . . . . . Jacqueline Gonnet

BUSINESS

BUSINESS MANAGER . . . . . J. G. Johnson
CIRCULATION MANAGER . . . . . T. J. Lucey
ASST. BUSINESS MANAGER . . . . . W. V. Cockren
PRODUCTION MANAGER . . . . . F. A. Dube

83,247 copies of this issue printed

The Navy's Polaris will use

3/4 OF THE GLOBE FOR A LAUNCH PAD

A solid-propellant missile that will be launched from ocean depths. A nuclear-powered submarine that will cruise for months without surfacing. The Navy has combined them in the Fleet Ballistic Missile system. Each nuclear sub will be a mobile missile base, capable of patrolling 70% of the earth's surface, ready to launch 16 Polaris missiles in as many minutes. Aerojet-General furnishes the propulsion for the Polaris missile, General Electric the guidance. Lockheed is prime contractor and system manager.

LOCKHEED MISSILES & SPACE DIVISION
SUNNYVALE, CALIFORNIA

Second stage of Polaris test vehicle, which has instrumented container on its nose, separates and ignites after first stage has hurled it into space.

OTHER LOCKHEED DIVISIONS: CALIFORNIA • GEORGIA • LOCKHEED ELECTRONICS CO. • LOCKHEED AIR TERMINAL • LOCKHEED AIRCRAFT SERVICE • LOCKHEED AIRCRAFT INTERNATIONAL • LOCKHEED, S. A. • PUGET SOUND BRIDGE AND DRY DOCK CO. LOCKHEED PRODUCTS: ELECTRONICS • MISSILES • AIRCRAFT • NUCLEONICS • SATELLITES AND SPACE VEHICLES • ROCKET FUELS AND MOTORS • AIRCRAFT MAINTENANCE • AIRPORT MANAGEMENT • SHIPBUILDING • HEAVY CONSTRUCTION • STEEL FABRICATION AND CRANES

EDITORIAL

Two Positive Programs

There are two new aircraft development programs looming on the horizon that need some extraordinary effort from the aerospace industry and the executive and legislative agencies of the government if they are to achieve any significant success in adding to our national stature. These programs will be dependent on the technical resources of the aerospace industry and, at least in one program, dependent on new and more effective utilization of these total resources. They will also require some new working relationships between the Air Force and the Federal Aviation Agency, as well as positive, sustained legislative and funding support from the Congress.

Both of these programs may be attacked on the grounds that they will serve only the "special interests" of the aerospace manufacturing and transport industries. But we doubt if these arguments will long survive the glare of full public scrutiny. Actually, both programs offer the opportunity for substantial national dividends on any initial federal investment and can produce major improvements in our civilian economy and our military posture. These programs are:

• **Development of a workhorse jet-powered cargo plane.** This is an urgent need for both civil and military requirements. The critical needs of MATS for a workhorse jet cargo plane to replace its aging fleet of C-124 piston-powered transports, which slow military air logistics to a Percheron's pace in a race horse era, have been well defined and substantiated. It is also evident that the military airlift potential, the civil airlines and the national economy would benefit greatly from a joint development program to meet this requirement.

It is true that all previous efforts to develop aircraft to serve both military and civil purposes have bogged down in the maze of specialized military requirements details and splintered on the rugged individualistic tastes of the airlines, who feel that a different colored cabin interior is a basic policy matter. However, we are reaching the point where some of the highly competitive individualistic bents of the airlines and some of the military detail adders must be subordinated to the key purpose of producing a new type aircraft that will do the military job and can also be operated by airlines at a profit.

We are not speaking now of the specialized craft for oversized military cargo such as the C-133 fleet designed to carry ICBMs, but of the intermediate class of cargo transports designed to carry all but this special outsized military cargo. This requirement has been tentatively defined in a USAF strategic operational requirement; some companies have done considerable preliminary design study toward it; FAA and USAF have coordinated on it far more than has been usual, and Congress appears ready to approve a $50 million increment in the Fiscal 1961 budget to start the development ball rolling.

This is a truly worthwhile project from the over-all national interest. It will help plug a generally admitted critical gap in military airlift capacity. It will also lift the civil air cargo business off its modest plateau and offer it an opportunity to make a major contribution to a more efficient national economy through adding a major speed increment to the distribution system. It will provide an opportunity to develop a large military cargo reserve capacity at very low cost through the operation of a profitable civil fleet of these aircraft which will be available in the tremendous transport crisis that would result from either another limited war such as Korea or a full-scale nuclear conflict.

The technical state of the art is well able to handle this development problem immediately. The problem is executive decision, administrative coordination between all of the groups directly concerned and some vital leadership that will provide sustained drive and maintain a sense of genuine national urgency behind this effort.

• **Development of a supersonic transport.** The national benefits from this project are less readily apparent than from the jet cargo plane, but they are substantial. The universally recognized world leadership of this country in air transport from the days of the DC-3 to the subsonic jet transport has not only been a substantial economic asset but tangible evidence of international prestige. The supersonic (and by this we mean Mach 2 or faster) transport will represent another major significant time compression in man's long effort to shrink the globe he inhabits. The nation that leads in this effort will gain significant international recognition, along with the passing curses of harassed airline presidents.

This program is of a technical and financial magnitude beyond the capability of any private industrial complex or any single government agency. An effective organization of all national resources available in this area must be achieved and focused on this goal for any real prospect of success.

Federal Aviation Agency has been effective in keeping the National Aeronautics and Space Administration's superb aeronautical research facilities active on this problem (AW May 2, p. 60). Many individual companies have had their designers exploring the possibilities beyond Mach 2. Unlike the jet cargo plane, the supersonic transport still poses many unanswered questions and has state of the art gaps in the broad technical spectrum its problems cover.

Although it may well be premature to attempt the actual construction of a Mach 2-plus transport aimed at early operational airline use, it is certainly high time that a national effort be organized aimed at achieving this goal. The necessary research and development gaps should be defined and then filled, and responsibility for the leadership of this program should be assigned.

It will be a sad day indeed if this country runs second best in the international race to produce a sound, economical operational supersonic transport.

These two programs for the development of a jet-powered cargo plane for both military and civil use and of a supersonic transport represent positive goals toward which both industry and government should address their very best efforts now.

—Robert Hotz

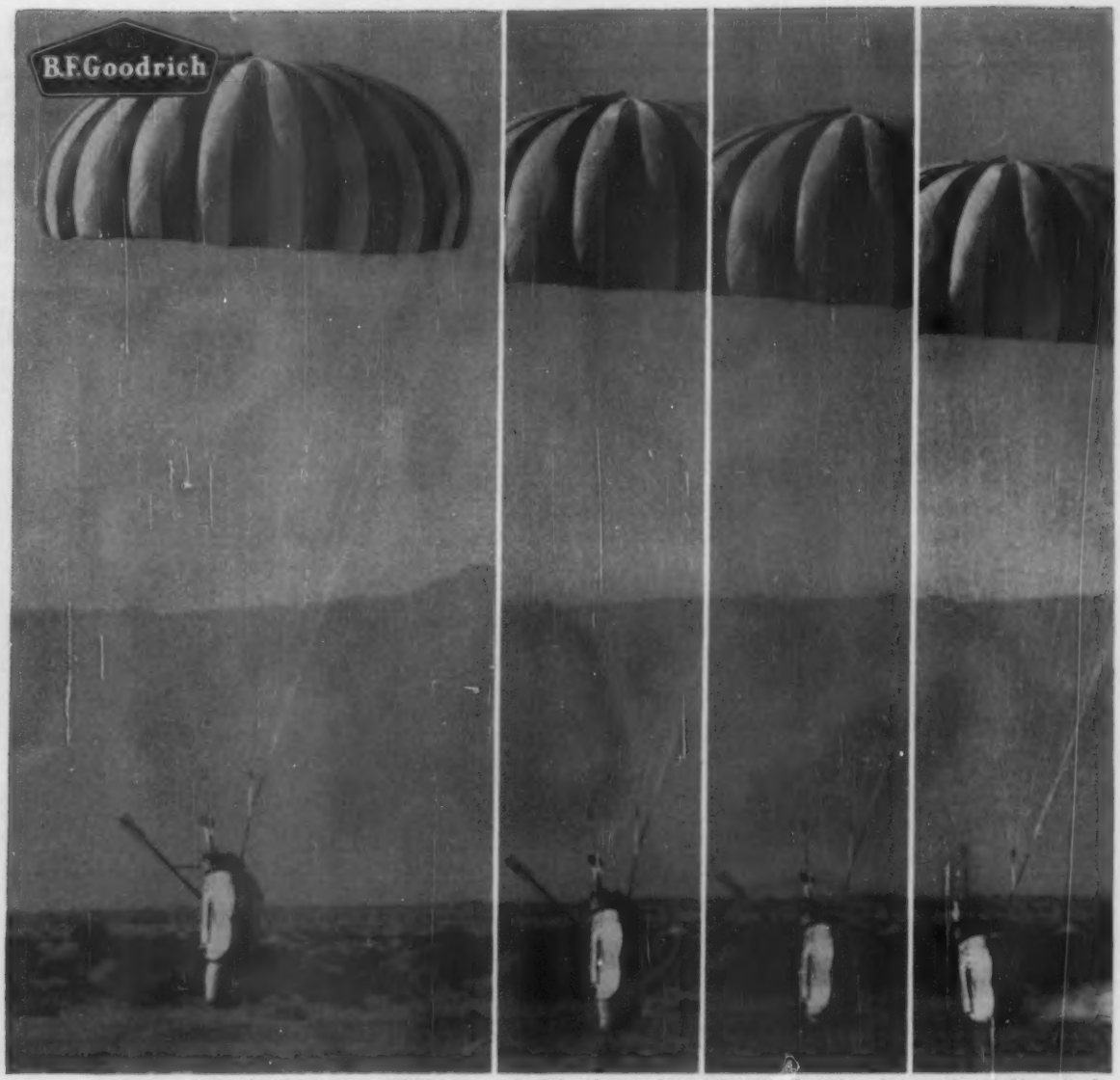


Photo sequence shows initial series of tests of B-70 escape capsule. In last photo note dust raised at right of capsule as air escapes through "blowout" valve.

Engineered "blowout" cushions landing

When this B-70 escape capsule hits the ground, the inflated rubber bag on the bottom absorbs initial impact—then the bag exhausts through a "blowout" valve just at the point of maximum compression to eliminate any bouncing "yo-yo" action. The bag must pack in minimum space, must inflate within 5 seconds.

B.F.Goodrich is equipped to engineer and build shock attenuator systems that meet demanding requirements like this. The systems are complete—comprising the flexible bag, valving and inflation device. Special BFG test facilities aid in engineering the right system to meet the specific requirements of load, approach speed, and tolerable G limits.

If you have a requirement for an engineered shock attenuator system check with *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Department AW-6B, Akron, Ohio.*

Use B.F.Goodrich shock attenuator systems on your advanced projects.

- Space vehicle payload landing
- Test missile recovery
- Helicopter power failure protection
- Capsule and cargo recovery

B.F.Goodrich aviation products

WHO'S WHERE

In the Front Office

B. F. Coggan, vice president-special projects, General Dynamics Corp., New York, N. Y. **Robert C. Loomis** succeeds Mr. Coggan as vice president and San Diego (Calif.) operating division manager.

M. Lloyd Bond, board chairman and chief executive officer, Northeastern Engineering, Inc., Manchester, N. H., newly acquired subsidiary of Atlantic Research Corp.

Vickers, Ltd., the English Electric Co., Ltd., and the Bristol Aeroplane Co., Ltd., have formed British Aircraft Corp., Ltd., to bring together their aircraft and guided weapon interests. Directors of the new company are: **Marshal of the Royal Air Force Viscount Portal of Hungerford** (chairman), **Maj. Gen. Sir Charles A. L. Dunphie** (deputy chairman), **George Nelson** (deputy chairman), **Sir Reginald Verdon Smith, Viscount Caldecote** (executive director-guided weapons), **Sir George R. Edwards** (executive director-aircraft), **William Masterton** (financial director), **G. A. Riddell** and **R. P. H. Yapp.**

Werner G. Holzbock, president, Continental Controls Co., Nashua, N. H.

Robert J. Garon, vice president of Wyle Laboratories, El Segundo, Calif., has been appointed general manager.

James R. Conto, vice president-marketing, Standard Rectifier Corp., Santa Ana, Calif.

Aircraft Armaments, Inc., Cockeysville, Md., has elected the following vice presidents: **Marvin J. Kahn**—marketing; **Raymond W. Wells**—engineering; **Irwin R. Barr**—development.

Dr. Edward B. Doll, vice president of Space Technology Laboratories, Inc., El Segundo, Calif., has been appointed director of the company's Systems Engineering Division.

Ling Electronics Division of Ling-Altec Electronics, Inc., Anaheim, Calif., has appointed the following vice presidents: **Robert F. Martin**—manufacturing; **Charles Theodore**—marketing. Also: **Edward P. Klein**, manager of systems engineering; **Edwin A. Andress**, sales manager; **Paul S. Goodwin**, chief engineer.

T. J. Harris, vice president and general manager, Aero Design & Engineering Co., Bethany, Okla.

Henry J. Hirtzer, vice president, Donner Scientific Co., Concord, Calif.

Carleton D. Smith, staff vice president—Washington, D. C., Radio Corp. of America.

Owen S. Olds, director of engineering and customer relations at Ryan's Electronics Division, elected a vice president of Ryan Aeronautical Co., San Diego, Calif. Also: **H. L. Fontaine**, vice president—operations at the Torrance (Calif.) electronics facility; **R. L. Clark**, vice president-works manager, San Diego.

Dr. Victor J. Young, vice president, Hazeltine Electronics Division of Hazeltine Corp., Little Neck, N. Y.

Arthur E. Raymond, former senior vice president-engineering for Douglas Aircraft Co. before retirement, has joined the staff of the Rand Corp., Santa Monica, Calif., as a special consultant.

(*Continued on page 127*)

INDUSTRY OBSERVER

► Configuration changes in the USAF-Douglas Skybolt air-launched ballistic missile (AW June 6, p. 23) have greatly increased original cost estimates for research and development phases. Team from Wright Air Development Division currently is being given a complete cost analysis briefing on the weapon system by Douglas management engineers.

► **Universal test set to be developed for Douglas Skybolt by Bendix will use an adapter so that it may be compatible with Skybolt, North American's Hound Dog and possibly other missiles in the air-launched category. One function of this piece of ground support equipment will be for automatic checkout of operating components while missiles are still in containers in storage. Total of approximately 55 sets is now planned.**

► Rocketdyne F-1 single-chamber, 1.5-million lb. thrust rocket engine will operate at a chamber pressure well over 900 psi. This is 30 to 50% higher than the chamber pressures in Rocketdyne engines on the Thor, Atlas and Saturn vehicles, and it will give the F-1 engine a higher specific impulse and permit the use of a shorter combustion chamber. Higher pressures in the F-1 were made possible through more efficient tubing design for regenerative cooling and improvements in materials and fabrication methods.

► **Lycoming Division of Avco Corp. expects certification of its T53 turbine engine this month. Production has begun on the 960 shp. T53-L5 helicopter engine, which recently passed 150-hr. qualification tests and will power the Bell HU-1B. Both the L3, being flown in the Grumman Mohawk and the L5 are now completely interchangeable except for the gearing. Lycoming also has received a development contract for its L7 turboprop version and L9 helicopter version, which is expected to power the HU-1D. Both are rated at 1,100 shp. The company plans to develop the T53 up to 1,400 shp.**

► Development of the control system for the USAF-General Electric direct-cycle nuclear turbojet engine now is being done by GE in its own facilities instead of by Marquardt Corp. Low funding level of the project is behind GE's withdrawal of the subcontract.

► **First missiles of the USAF-Martin Titan J series are at Cape Canaveral, Fla., and first firing is expected within approximately six weeks. Titan J, which will be fired as soon as the current G series is finished, is quite similar to the G but is the operational prototype. Missiles to be fired from Vandenberg AFB will carry a V designation, or VS if they are to be launched from a silo. Those located at other field sites will be designated only SM-68s.**

► First launching of a USAF-Martin Titan from Vandenberg AFB now is expected about October. Both the J series to be fired from Air Force Missile Test Center and the Vs to be fired from Vandenberg will carry a small amount of instrumentation to help determine performance, accuracy, etc. Shortly after the first flight from Vandenberg, the first silo launching from the same base will be attempted. Silo elevator and other systems are being checked out now with a ground missile, designated BH, which is a leftover from the B-lot reworked to carry the subsystems of an operational missile.

► **Fighter test branch at Air Research and Development Command's Wright Air Development Division has been reduced to 14 aircraft and 14 pilots from a former strength of about 30 pilots and 30 aircraft, which handled more than 100 active projects.**

► Next likely step in consolidating USAF flight test personnel and equipment is move of Wright Air Development Division's all-weather flying branch from Wright-Patterson AFB, Ohio, to the Flight Test Center at Edwards AFB, Calif. Reasons are congestion in the Dayton, Ohio, area, closer location of Edwards to cold-weather test sites in Alaska, and hot-weather testing aspects and general safety in the Edwards area.

LIBRASCOPE COMPUTER FACILITIES

Shown below is a composite view of Librascope's facilities where a variety of computer systems are currently in different stages of design and production. Some are strategically involved with national defense...others deal with business and industrial process control. Each is uniquely designed to answer a particular need. The success of these systems illustrates the value of Librascope's engineering philosophy: A decentralized organization of specialized project teams responsible for assignments from concept to delivery...and backed up by excellent research, service, and production facilities. For your computer requirements, call on the company whose breadth of diversification in computer technology is unsurpassed. ■ Librascope Division, General Precision, Inc., 808 Western Avenue, Glendale, Calif. For career opportunities write to John Schmidt, Engineering Employment. ■

computers that pace man's expanding mind

Washington Roundup

Rockefeller's Challenge

Pressure for debate of defense and other election issues developed on the Republican side last week. New York Governor Nelson Rockefeller startled the party by demanding the views of Vice President Richard Nixon and presenting an aggressive national platform of his own.

Rockefeller forced the issue on Nixon's decision not to discuss his own philosophy until after the Republican convention. The New York governor said the leading Republican candidate should make his programs and policies known before the party commits itself by nominating him. Nixon has generally stuck to defending present Republican policies on defense and other issues.

Rockefeller wants to spend an extra $3 billion for immediate defense needs. He feels U. S. ICBMs are too few and too vulnerable to attack. He wants an airborne alert to protect the SAC bomber force, and he wants new bombers developed. More Polaris submarines and ground force modernization are also on his list.

Tighter organization of the Defense Department is in the Rockefeller platform. So is a more flexible, better balanced defense establishment and philosophy, one which would be ready for all emergencies, including local wars.

Rockefeller cited handling of the U-2 incident as evidence of a need for better government organization to meet national and international problems. Sen. Henry Jackson also got into the U-2 controversy last week with his subcommittee on national policy machinery. Secretary of State Christian Herter was scheduled as the first witness, to be followed by Defense Secretary Thomas Gates.

U. S. approach to the disarmament problem was termed another show of government machinery weakness. Rockefeller called for a more vigorous approach. He decried lack of preparation for disarmament conferences and the U. S. tendency merely to meet crises as they occur.

Disarmament Hopes

Faint hope for a disarmament agreement has survived the summit crisis. Soviet Union has proposed a new plan, and the U. S. has promised to give it careful consideration at the Geneva disarmament meetings which resumed last week. Soviet proposal indicates a willingness to continue serious negotiations, but Western negotiators are wary of provisions calling for initial elimination of nuclear weapon delivery systems and overseas bases.

Brig. Gen. Homer A. Boushey, who headed USAF's first space office at the headquarters level, is being assigned to head ARDC's Arnold Engineering Development Center. He will be replaced by Brig. Gen. Richard Curtin, who has been handling space activities for Ballistic Missile Division.

Curtin will wear two hats as the result of a recent reorganization. He will have Boushey's old job as assistant for advanced technology to Deputy Chief of Staff for Development Lt. Gen. Roscoe C. Wilson, and he will be deputy director of the new Systems Development Directorate which is headed by Maj. Gen. Marvin C. Demler.

Maj. Gen. Victor R. Haugen has moved from director of development planning to assistant deputy chief under Wilson, replacing Maj. Gen. Leighton I. Davis, new head of Air Force Missile Test Center. Haugen is replaced by Brig. Gen. W. B. Keese in the planning job, and Brig. Gen. Ralph L. Wassell is heading the new Directorate of Research and Technology.

Defense Department is studying the idea of centralized management of electronic supplies and materiel proposed by General Accounting Office. GAO estimates that centralized management could save more than $25 million a year in administrative costs and through elimination of duplication.

AFMTC Independence

Watch for Air Force Missile Test Center to stay essentially independent of Ballistic Missile Division in the ARDC reorganization pattern. This is a reversal of earlier plans to put the center under BMD in line with the pattern of placing all centers under one of ARDC's four new divisions.

Four major ARDC divisions will function primarily as headquarters elements under the most recent concept. They will have staff direction functions, but not full command.

BMD complement at Cape Canaveral will be strengthened, but AFMTC will retain its present level of autonomy. This stems partially from the fact that the center has the two other services and NASA as users of its Atlantic Missile Range. With former AMR commander Maj. Gen. Donald N. Yates coordinating range operations for the Defense Department, the Florida center's importance and relative independence may even be greater than it has in the past.

Col. Henry Eichel, head of the BMD detachment at Cape Canaveral, is returning to BMD headquarters. He will head a new division that will deal with installation and checkout of missile squadrons at field bases. Eichel is being replaced at AFMTC by Col. Paul Wignall.

—Washington Staff

Senate Group Increases B-70 Budget

$285 million voted to boost Mach 3 bomber program; extra funds approved by House for air alert eliminated.

By Katherine Johnsen

Washington—Senate Military Appropriations Subcommittee gave the B-70 bomber a major boost last week by approving an extra $285 million for the program in Fiscal 1961. The group also eliminated $115 million approved by the House for Strategic Air Command's airborne alert program.

Funds added by the Senate group for continued production of the Bomarc-B air defense missile and funds for F-106 interceptors eliminated from the budget seem likely to produce a fight when the defense budget reaches the Senate floor, probably this week.

Senate Appropriations Military Subcommittee headed by Sen. Dennis Chavez (D.-N. M.), after considerable controversy, approved an extra $294 million for Bomarc, and eliminated $215 million voted by the House to purchase 50 F-106s. Sen. Chavez anticipated that senators favoring the interceptor would carry their case to the floor. He said some senators "have the laudable ambition" of moving forward with both programs for air defense against manned bombers.

The Administration, including the Air Force, strongly supports the $294 million for Bomarc. The House, however, on the heels of several Bomarc test failures, completely eliminated funds for the operational program, allowing only $50 million for development testing. It substituted the $215 million for the Convair interceptors. The vote in House Appropriations Committee was close, and since it was taken there have been several successful Bomarc test firings.

The net result of revisions is an increase of approximately $1 billion in the $39 billion Fiscal 1961 defense budget recommended by the Administration. Several senators—including Sen. Stuart Symington (D.-Mo.) and Sen. Henry Jackson (D.-Wash.)—have proposed an increase in the neighborhood of $2 to $3 billion.

Senate Appropriations group made these major changes:

• **B-70 bomber.** The $285 million additional approved by the Senate group, together with the $75 million recommended by the Administration and already approved by the House, would make a total $360 million available for the program in Fiscal 1961. The $75 million contemplates research and development on two prototype aircraft. The additional funds would permit USAF to develop the aircraft as a weapons system.

• **Airborne alert.** The Senate subcommittee eliminated $115 million added by the House to the $85 million requested by the Administration to develop an air alert capability for one-fourth of the SAC B-52 fleet. It approved a provision—also approved by the House—which gives the President authority to use funds for an airborne alert whenever he might deem it necessary. Gen. Thomas S. Power, SAC commander, recommended that an airborne capability be developed for one-quarter the SAC heavy bomber fleet—instead of the one-eighth in the Administration program. He estimated this would require approximately $570 million in addition to the $85 million.

• **Aircraft carrier.** The full $293 million asked by Navy for a new conventional carrier was approved.

• **Polaris program.** The Senate subcommittee went along with the House and provided for full funding of five Polaris-equipped nuclear submarines and partial funding of seven in Fiscal 1961, instead of full funding of three and partial funding of nine as proposed by the Administration. This added $241 million to the $1.1 billion for financing the Administration program.

• **MATS modernization.** The $200 million voted by the Senate group for interim modernization of Military Air Transport Service with Lockheed C-130E (extended range C-130B), Boeing C-135 (cargo version of the KC-135), or similar aircraft, split the difference between the $250 million approved by the House and the $150 million proposed by Defense Department.

A provision approved by the House, which would require MATS to earmark $80 million for contracts with commercial carriers for airlift, was rejected by the subcommittee.

• **Contract costs.** The subcommittee turned down an across-the-board reduction of 3% in all procurement categories—a total of $400 million—imposed by the House in a move to "force" savings in contract costs. Defense Department and the three services vigorously opposed the provision, said savings of $400 million could not be made by tighter contracting and cutbacks in procurement would be required.

The Senate subcommittee also eliminated $20 million for development of the Minuteman intercontinental ballistic missile and $54 million to speed work on the Midas, Samos, and Discoverer satellite projects added by the House. The reasoning behind the action was that if additional funds are needed for these projects during the year, they can be obtained from Defense Department's $150 million emergency fund or other ways.

USAF Space Pilots

Los Angeles, Calif.—Pilots for future space missions will be chosen from a cadre composed of recent graduates of the Air Force Experimental Test Pilot School and pilots who were considered for Project Mercury. Pilots for Dyna-Soar will be chosen from this group of about 200 top experimental pilots. Air Research and Development Command keeps current files on the location and activity of each man in the group, even if he is on duty with another command. A group similar in size to the Project Mercury pilot group will be selected for Dyna-Soar, probably 18 months before the first flight.

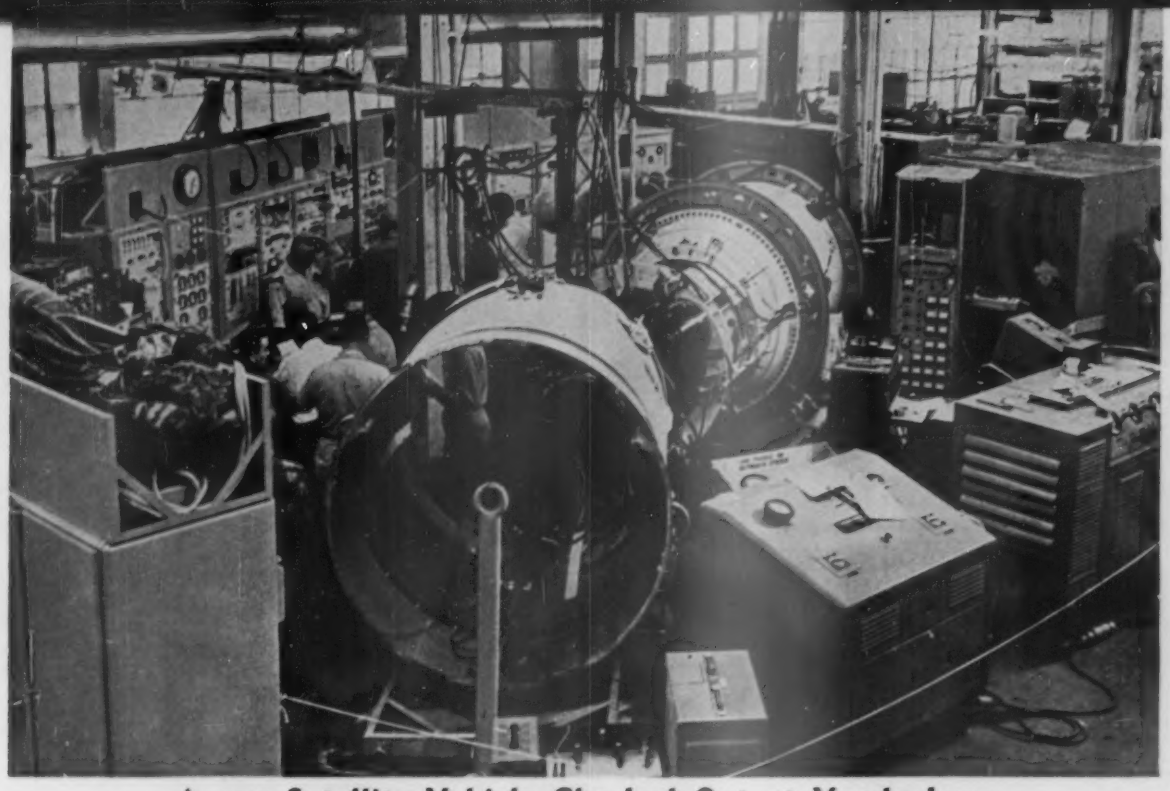
Canadian Bomarc

Washington—Additional $294 million voted for the Bomarc program by Senate Military Appropriations Subcommittee would include funds for the two Bomarc-B squadrons Canada plans as part of its air defense complex.

House action cutting the Bomarc program has raised a political storm in Canada, since the Canadian government earlier decided to abandon its Avro CF-105 project in favor of buying the Bomarc-B from the U. S. Prime Minister John G. Diefenbaker discussed the Bomarc situation with President Eisenhower during his recent visit here.

Purchase of the Bomarc is tied in with a long-time Canadian goal to obtain a parity with this country in exchanges of defense hardware. One proposal under consideration is sale of 30 to 50 CL-44 aircraft to U. S. as part of the MATS transport replacement program. In return, Canada would receive equal dollar value in Bomarc missiles, plus several Convair F-106 or McDonnell F-4H jets.

Construction of Canadian Bomarc-B installations at North Bay, Ont., and Mont. Laurier, Quebec, has not been curtailed since the USAF proposed a reduction in the Bomarc program to Congress in March.



Agena Satellite Vehicle Checked Out at Vandenberg

Agena satellite vehicle is checked out at Lockheed Missiles and Space Division's facility at Vandenberg AFB, Calif., before being delivered to the launch pad. Checkout equipment surrounds the vehicle during this final inspection and modification period. Vehicle shown is a non-restartable version of Agena. Tests are being made of guidance, control, attitude and propulsion systems.

USAF Awards Solar Power Study

Pacoima, Calif.—Phase I contract leading to development of a flight prototype of a 15 kw. solar-mechanical space auxiliary power unit capable of one year continuous operation has been awarded Turbo Division of Sundstrand Corp. First phase contract is worth $1 million, extends for 15 months and calls for design and fabrication of a breadboard system.

The solar-concentrator, Rankine cycle turbine powered generator system is a state-of-the-art advancement project, Sundstrand says, rather than an effort to get an operating system as soon as possible. Therefore, new approaches have been used in many areas to establish feasibility. Contract was awarded by Wright Air Development Division.

Contemplated system would have a specific weight of less than 60 lb./kw., Sundstrand says, including sun seeking orientation unit, attitude stabilization and turbogenerator control system. Total weight would be 900 lb. or less.

Design calls for paraboloid reflector-concentrator which will direct solar rays into a cavity absorber where heat will be transferred to the working fluid which will power the turbine-generator. Working fluid will not be the standard mercury vapor whose properties and characteristics are well known, but a significantly lighter medium which also will provide a considerably higher turbine inlet temperature than has been used in mercury units.

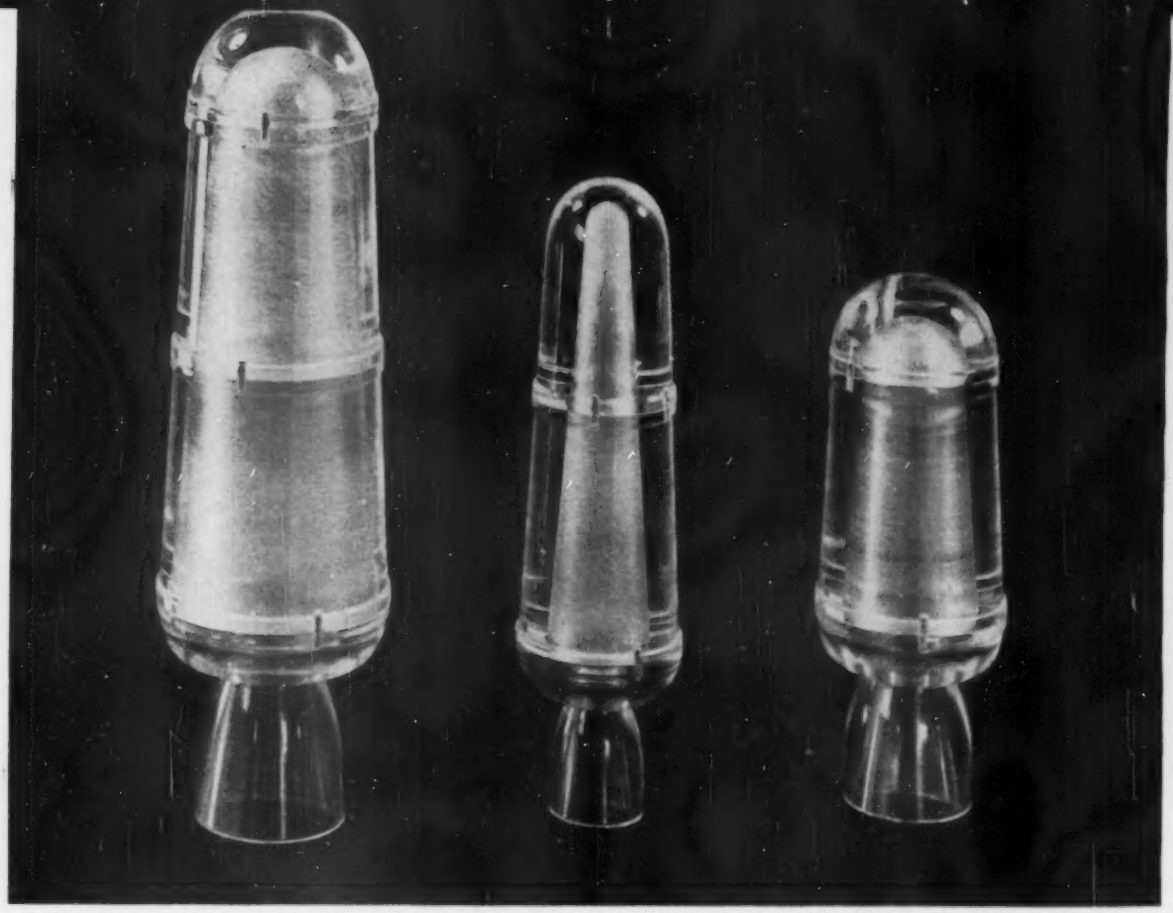
System also will incorporate a thermal storage unit to provide a heat source while the vehicle is operating on the dark side of the earth.

To achieve its specific weight, Sundstrand is working for advanced efficiency in several areas of the solar-mechanical system, including:

- **More efficient turbo machinery**, including the lighter working fluid. Specifications call for angular momentum of 1.67 lb./ft./sec. from rotating elements and 0.02 lb./ft./sec. from the moving fluid.
- **Lightweight thermal storage.** Sundstrand has a separate contract from WADD for investigation and development of thermal storage approaches from all types of applications using solar heat. Outcome is regarded as important to entire solar power field, where operations during dark side time pose a considerable problem.
- **Reflector weight.** A deployable concentrator designed for zero g operation has not yet been built, Sundstrand points out, and if one is, it still faces problems such as testing. Earth's 1g field would make this unrealistic. Sundstrand indicates that the zero g concentrator and engine may not be brought together until they are in space. Other problems are that a concentrator built for zero g may be subject to radiation damage from high energy particles, since it will be extremely light. In addition, the shape of the paraboloid is critical and must be held to close tolerances, and the highly reflective surface will have to be smooth for efficient operation. Still another factor is that launch accelerations must be successfully withstood by the concentrator, regardless of the configuration in which it is stored for rocket powered flight.

Sundstrand power system could be attached to the primary vehicle two ways—one would have the power unit mounted on a boom away from the vehicle, where it would have its own orientation sun seeker, attitude stabilization controls and operate independently. Other scheme would have the system an integral part of the vehicle, with the sun seeking orientation being the prime attitude sensor for the whole vehicle. The whole vehicle attitude would be stabilized and changed according to the power unit's solar requirements. Orientation probably will have to be maintained to within approximately one degree.

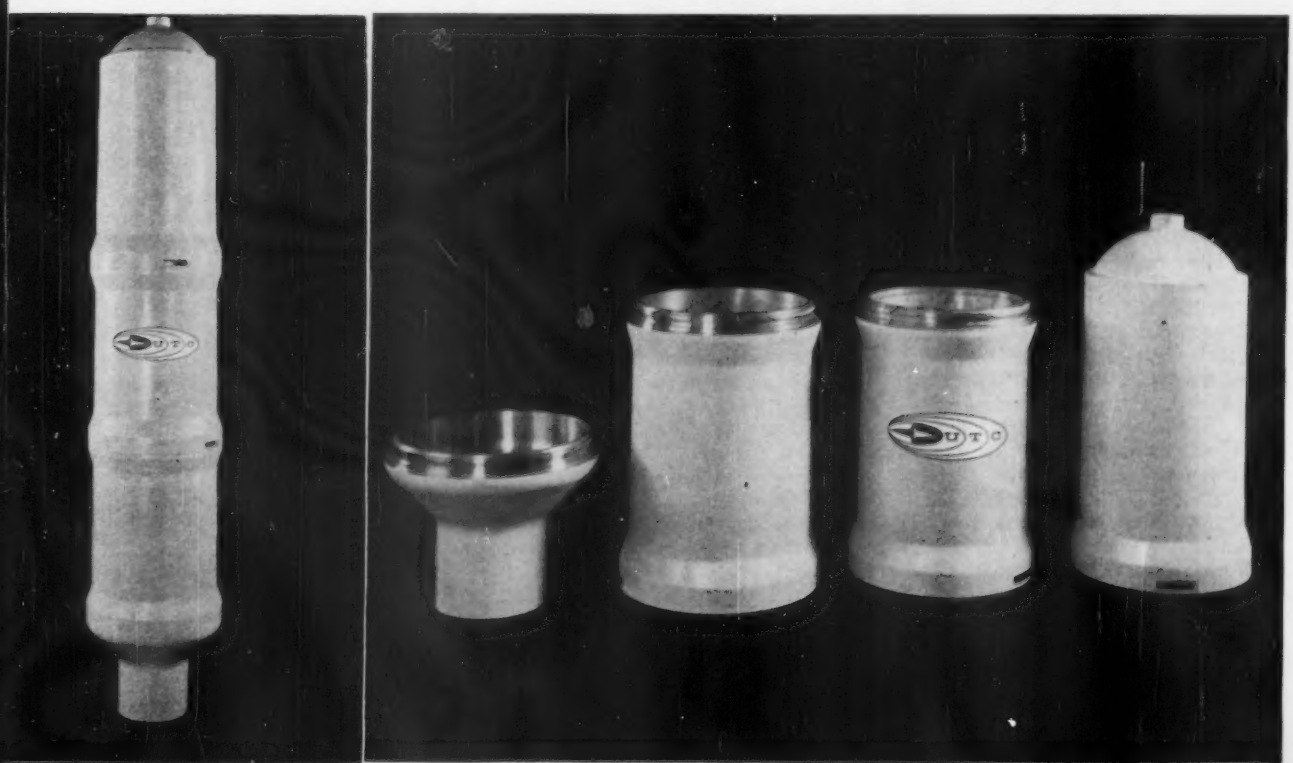
Sundstrand estimates it would take a program lasting five years and costing $12 million to obtain a system for flight with enough promise to justify cost of using a booster to put it in space.

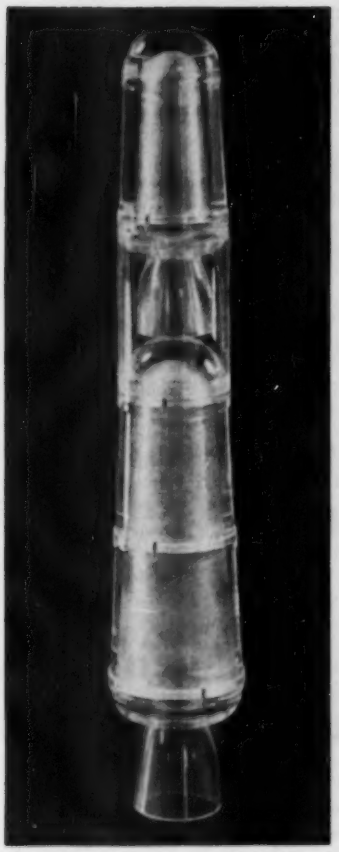


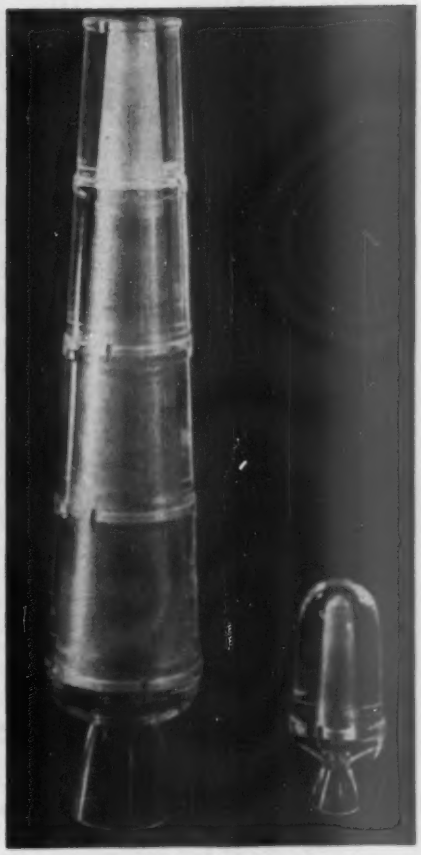
FLEXIBILITY of conical segmented solid propellant rocket motor concept being developed by United Technology Corp. is demonstrated with plastic models which have been fitted with individual nozzles to show how motors of various thrust ratings could be formed.

Segmented Solid Rocket Techniques Hold

NOZZLE of conical segmented solid propellant rocket motor (model at left) would be contained in housing at bottom. Connections for joining segments are visible at base of each of two upper stages. Same rocket model is shown disassembled at right.







TWO-STAGE rocket model (left) is formed from conical segments. At right above, top segment of a motor assembly has been removed to form a small independent rocket motor.

Promise for Big Boosters

Sunnyvale, Calif.—Solid propellant rocket manufacturing techniques already developed or being explored by United Technology Corp. under a contract with National Aeronautics and Space Administration are expected to eliminate the need for on-site loading of large solid boosters, cut cost and complexity of production and lessen the amount of development and test work necessary.

One of the most promising approaches to building very high-thrust boosters of either the liquid or solid-propellant variety appears to be the building-block or segmented engine. This is now being explored for solids by a number of companies and is the approach required in USAF's upcoming 20-million lb./sec. competition (AW Nov. 23, p. 32). It also is being investigated for liquid engines (AW Feb. 1, p. 16).

United Technology claims an additional advantage for its approach on solid engines. Because the segments are conical in shape rather than cylindrical, with the small end at the top of the engine, the flow area increases as length of the charge increases. This allows almost unlimited increase in length without erosive burning, providing more reliable prediction of ballistic performance and decreasing the amount of testing necessary, according to Willem Schaafsma, manager of the solid rocket branch.

Problems Overcome

United has fired a small conical segmented engine and says that all major design and fabrication problems have been overcome. The NASA contract (AW June 6, p. 32) calls for demonstration of feasibility of the concept, using a small engine believed to develop less than 20,000 lb. thrust. United has proposed building an engine in the 1 million lb. thrust class, using segments some 10 ft. long and 10 ft. in diameter, and says segments can either be stacked to form one long charge or have nozzles added to each segment or group of segments to form a staged rocket.

Segments can be joined in the field with a weight penalty of less than 10% under a method already developed.

THREE-STAGE configuration has nozzle below the two top segments, another after the third segment and the third at the base of the rocket. Spent segments drop off in flight to lighten load, add range.

Defense Objects to Listing Rules In House Conflict-of-Interest Bill

Washington—Department of Defense is urging the Senate to reject a provision in House-passed legislation which would require defense contractors to submit a list of all ex-military officers on their staff with each contract proposal (AW Apr. 18, p. 32).

The provision would also require prime contractors to furnish lists of all ex-military officers employed by their subcontractors. The penalty for not complying would be suspension of contract payments.

In testimony before the Senate Armed Services Committee on the conflict-of-interest legislation, Charles C. Finucane, assistant secretary of defense for manpower, personnel, and reserves, said that the net effect would be a refusal on the part of contractors to hire any former military officers. He noted that the bulk of World War II officers, generally in the 43-45 year age category, with the rank of major or lieutenant colonel and without "influence" in the Department, will enter the employment market in the 1961-63 period.

The administrative burden which the requirement for listing all former military personnel employed would impose on contractors, plus the possibility that the contractor might be criticized for hiring "influence," Finucane maintained, "would unduly prejudice the employment opportunities afforded retired officers . . . vast numbers of whom are relatively young and without departmental influence."

Finucane reported that since the start of conflict-of-interest hearings (AW Aug. 24, p. 33) before the House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert (D.-La.), "we have encountered great difficulty in many of our people getting employment.

"Defense contracts, in many cases, can be of such great financial significance and can constitute such a major portion of the contractor's total sales that no risk, however remote, would be taken by him which might jeopardize payment under a defense contract. Already we have evidence which supports this contention," he said.

Defense Department position on other key provisions of the conflict-of-interest legislation:

• **Cooling-off period.** Finucane agreed that there should be a two-year ban on selling by ex-officers to Defense Department, but he suggested that it should only apply to those with the rank of colonel or captain (naval) and higher. He said those of lower rank do not have "influence."

• **Definition of "selling."** Finucane asked that this detailed definition of "selling" be written into the legislation: "Selling means (1) signing a bid, proposal, or contract; (2) negotiating a contract; or (3) contacting an officer or employe of the Department of Defense who is vested with authority to make or negotiate a contract for the purpose of (a) obtaining or negotiating contracts; (b) negotiating or discussing changes in specifications, prices, cost allowances, or other terms of a contract; or (c) settling disputes concerning performance of a contract."

The legislation passed by the House simply bans "any transaction the purpose of which is to sell or to aid or assist in the selling of anything."

• **Public enrollment.** Finucane supported the provision in the House-approved measure requiring public enrollment by former officers employed by defense contractors. Under questioning, he said he would prefer to have the register secret, available only to Congress.

• **Criminal penalty.** Finucane took no position on the imposition of criminal penalties—$10,000 fine and/or two years imprisonment—proposed for officers who violate the two-year ban on selling and the contractors who employ them.

Rep. Hebert, with the support of the Justice Department, urged Senate Armed Services Committee to include these penalties in the bill. Under the measure passed by the House, officers who violate the two-year selling ban would be subject to court-martial. No penalty is provided for the contractors who employ them.

Hebert doubted that a court martial would ever be held, and if it were, he said, it would turn out to be "just an old class reunion."

New Curtiss-Wright Management Prepares to Reorient Company

New York—Curtiss-Wright Corp.'s change in management will mean more emphasis on company-originated product development and less development acquired through licensing of foreign projects.

This is indicated by T. Roland Berner, who replaced Roy T. Hurley as chairman and chief executive officer of the company after Hurley's resignation (AW May 30, p. 34). Berner said the company also would:

• **Seek new military business** in a move to reassert Curtiss-Wright's position in the defense field. The company's military/commercial business ratio is now approximately 50-50, but the military side has been declining. Berner commented: "It's an ideal situation that's not ideal."

• **Eliminate certain product lines** which had proved to be very unprofitable.

Curtiss-Wright has a tough shakedown period ahead, Berner said. The company will not only have to face re-evaluating its own programs, and possibly accepting bitter pills in the form of write-offs and retrenchment, but also the changing complexion of the defense market where some companies will become surplus to military needs.

An indication of the re-emphasis on military business was that Berner, though he had only been in the job 10 days, had already been to Washington to discuss defense requirements. Among those he saw were the Secretary of Defense, Secretary of the Army and the chief of the Polaris missile project.

What direction the product reorientation will take was not described by Berner. He noted the phasing out of the J65 military turbojet engine, though it will still provide a large volume of spares business, and of the Turbo Compound piston engine. He showed little optimism in breaking into the current class of jet transports with an engine without military support.

One specific product Berner mentioned was the rotary engine licensed by Curtiss-Wright from NSU in Germany (AW Apr. 18, p. 73). Its commercial potential and feasibility are under evaluation. Asked if he were as enthusiastic about the ground effect vehicle Curtiss-Wright is developing as his predecessor was, Berner commented only: "I'm not as high on anything as Mr. Hurley was."

Curtiss-Wright's product line is too broad and too thin, Berner said. The company has serious problems and will have to take some losses.

Generally speaking, Berner noted, it may be necessary to redirect the attempts of a large group of people to new areas. There are a variety of development programs in progress in Curtiss-Wright, he said, and this redirection might consist of stressing concentration in certain areas of already-begun development programs. Berner said Curtiss-Wright had technological brains and that one phase of the reorientation would be to put these brains to work with the proper administrative support.

Berner indicated a lack of interest in

any further flirting with the consumer field, as represented by the Curtiss-Wright interest in Studebaker-Packard four years ago. "We're certainly not a consumer-oriented organization," Berner said. "We have not developed the skills to handle these areas. It would be with the greatest of caution that we would go into these areas."

Other points along this line:

- **Electronics capabilities** of Curtiss-Wright will be expanded.
- **No new financing** is expected to support the company's reorientation.

Berner is acting as chief executive officer of the company now, but he said the search is on for a president, noting that the decision will be made then on whether to make him chief executive officer. If the right man could be found, Berner will be willing to step aside to permit naming him president and chairman; on the other hand he is willing to stay as chairman if it is felt necessary.

Several allusions by Berner touched on the previous operation of the company. "There won't be just one brain," he said at one point. Referring to publicity at another point, he said: "We're going to see that what comes out of there [Curtiss-Wright] has character and integrity." He also said he wished to correct some impressions that did not result from action by the directors, apparently a reference to the announcement of the NSU engine license just prior to a dividend cut.

The resignation of Hurley took place at the May 25 board meeting and Hurley has no connection with the company now. Berner said that Hurley had come into the May 25 meeting with a memorandum to the effect that he was to be given a much freer hand, greater authority.

"I'm not mad at anyone," Berner quoted Hurley as telling the board. "If you fellows don't want it that way, I'll be glad to do what you want . . . to work on new products . . ."

Hurley then was requested to leave the room while the board discussed the proposal. After clarifying that Hurley's alternative to more authority was that he was to leave all his posts—president, chairman and director—the board voted to accept his resignation unanimously.

United, Convair Struck; NAA Settles

By Richard Sweeney

Los Angeles—Aerospace industry labor picture was clouded by a series of strikes last week, but North American Aviation signed a two year agreement with the United Auto Workers.

International Assn. of Machinists struck the Convair Division of General Dynamics Corp., concentrating on Convair-Astronautics and hampering work on the Atlas ICBM. Violence flared as several United Aircraft Corp. divisions in Connecticut were struck.

North American signed a new two-year agreement with United Auto Workers under which fringe benefits worth about 9 cents an hour are effective this year and a new base pay rate which includes cost-of-living advances from the last contract period was established. A cost-of-living clause was included in the new contract, and a flat seven cents an hour pay boost was granted, to start next year. This pattern, in which no direct pay increases were set for this year but fringe benefits were hiked, and a flat pay hike scheduled for a year from now, was viewed as some basis for other settlements in the industry.

Strike by IAM against Convair Division of General Dynamics, aimed mostly at Atlas ICBM-producing Astronautics Division, produced picket lines at Cape Canaveral, Fla., Vandenberg, Warren and Offutt Air Force Bases (see box) in addition to the missile plant in San Diego, flight test facilities at Edwards AFB, Palmdale, Calif., and Holloman AFB, N. M.

Strikers clashed with police while trying to bar a truck from entering the struck plant of United Aircraft Corp.'s Hamilton Standard Division at Windsor Locks, Conn. United Auto Workers were scheduled to strike seven UAC plants today, but the walkout started last Monday at Sikorsky Division when a dispute arose over some notices left by workers Sunday night which were confiscated by a foreman. When the union demanded them back, the company refused. By Tuesday, an officially-approved strike was in progress.

Negotiations between the Machinists and Lockheed Missiles and Space Division broke off last week after 10 weeks of bargaining which L. A. Mitchell, the division's industrial relations director, said had "made little progress in resolving any of the more than 100 contract changes originally proposed by the union." Mitchell said the issues include compulsory union membership and compulsory payment of dues by nonunion employes, wage and fringe benefit demands totalling more than the 14% IAM says it wants over the next two years and a $1.23 per hour bonus for employes assigned to test bases.

Mitchell said when the negotiations were interrupted that union representatives "expressed their unwillingness to alter their major demands, even though these are far in excess of any settlement or company offer made in our industry on the West Coast."

Cape Canaveral picket lines set up by striking Convair IAM members at North and South gates, only land en-

Atlas Site Picket Lines

Picket lines of striking International Assn. of Machinists at three Atlas ICBM launch sites last week produced these results:

- At Vandenberg AFB, Calif., some confusion resulted last Monday morning, with members of other unions honoring the IAM picket lines for a while. However, these workers went through the lines later in the day or the next day, leaving only 511 Convair IAM hourly workers off their jobs at midweek. Work on Atlas facilities in the construction stage went on unhampered.
- At Offutt AFB, Neb., there were two sets of picket lines, one placed by Convair IAM employes, the other by a local Omaha union which was protesting a roadwork contract on the base which was awarded to an Oklahoma firm. Workers at the main Offutt base who are in the building trades stayed off their jobs, but probably to respect the local picket line rather than the Convair line. Evidence of this was given in the fact that at the three dispersed missile launching sites, where Convair IAM pickets alone were present, the building trades and all other unions crossed the line and worked. Effect was similar to that at Vandenberg—where Convair technical trade people of the IAM were needed in installation of equipment, work was affected, but ordinary construction work continued. Offutt had 287 Convair IAM workers off the job at midweek.
- At Warren AFB, Wyo., work was affected on those launch sites where Convair technical trades people were installing equipment, which includes four launch sites with a total of 15 actual launch pads. Another Warren installation, involving nine launch pads at individual sites, continued under construction, since only brick and mortar work is being done. Warren has three Atlas squadrons, each deployed differently, accounting for the variations in numbers of launchers at each site. At Warren, building trades unions met early last week and voted to continue work despite the IAM picket line. There were 402 Convair IAM workers off the job at midweek.

trances to Air Force Missile Test Center's launch area, were being honored by all 26 unions represented at the Cape on Monday, effectively slowing down operations. By midweek, some members of all unions on the base, including IAM people working for contractors other than Convair, had returned to work, except for 2,000 construction trades people.

At Convair San Diego and Astronautics plants, IAM adopted tactics which left majority of union workers on the job during the week. With "selective walkouts," certain types of workers were being held off the job on a day-to-day basis. Premise was that most workers would keep getting pay checks but could be called out at any moment.

Convair obtained an injunction against mass picketing, and during a negotiating session the company informed the union that it no longer was collecting union dues from employes or observing union grievance procedures. Company informed its employes that economic terms of the old contract would continue in force pending a new contract.

Meanwhile, Douglas Aircraft, negotiating with both the IAM and UAW, presented proposals which the company said equaled or bettered the North American agreement and which were being studied by union negotiators.

Chance Vought, negotiating in Dallas with UAW, had not yet reached the stage of economic terms, but was still discussing such issues as job descriptions, overtime assignment and distribution.

Generally speaking, direct financial aspects of contracts were taking second place in bargaining to non-economic terms the unions are striving for in the current period of industry change.

Space Research Policy Criticized

Washington—Much of the national space program is inadequately backed up by fundamental research and development work essential to its proper growth and execution, according to Dr. Fred L. Whipple, director of the Smithsonian Astrophysical Observatory.

Dr. Whipple told a meeting of the House Space Committee's Panel on Science and Technology that the small amount of money saved now by neglecting basic research may cost hundreds of millions of dollars to provide the same answers in the future.

Dr. James A. Van Allen, professor of physics and astronomy at Iowa State University, charged that many federal agencies, including the National Aeronautics and Space Administration, have not taken the "proper view of the needs of universities" for physical facilities such as research laboratory buildings and experimental equipment.

One possible answer to the inadequate research problem, Dr. Whipple said, is to set up an individual or a group with a separate, protected budget, possibly within NASA or the National Science Foundation, with the following missions:

- **To study the problem** of back-up research for the space program.
- **To encourage research** in critical backward areas.
- **To fund research programs** as required when they do not fall easily into the normal disciplines or categories of funds.

The nature of the lunar surface is a question of the greatest importance theoretically and practically, Dr. Whipple said, and a few hard or soft landings with limited equipment will not necessarily "give us a general answer to this question." He said he believes the problem could be answered in the laboratory at about one per cent of the cost of a rather simple lunar probe and with adequate certainty for the engineering requirements.

Physical environment which affects the moon's surface is known, within limits, he said. "We can vary our experimental conditions and assumed chemical composition over an adequate range to cover all of the likely and most of the possible situations that may obtain there. The time scale can be speeded up by an enormous factor so that the experiment need not stretch out unduly."

Dr. Whipple predicted that the moon-surface experiment will be carried out "inadequately" and that "rather large expenditures will be made" to answer the questions mostly from the moon itself.

Lack of support for basic research in seismology has also kept progress at a low level, he said, "Yet at enormous expense, we will place simple recording seismographs on the moon and planets." He questioned whether "we know enough about seismology and the interior of the planet earth to plan a proper experiment for the moon, Mars or Venus."

In the highest part of the atmosphere and in space sciences, Dr. Whipple said, one of the least expensive and valuable backups to the space program is the high-altitude balloon, which is "essentially a homeless orphan" except for the limited but highly effective support given by the Office of Naval Research and to some extent by the Air Force. Dollar for dollar, he estimated balloon research should pay off at somewhere between 10 and 100 to 1 over satellites and space probes in terms of space science results.

In another area, Dr. Whipple said that ground-based activity to back up space engineers in the field of meteoritics is "still operating at a snail's pace compared to its proper rate. By saving a few hundred thousand dollars a year in meteoritic research, we may lose hundreds of millions of dollars in our space program."

He also urged that attention be given to research and development of remote controlled robots for space vehicles, which he said can do everything that a man can at far less expense, weight and emotional concern, if there is television contact with the man on the ground controlling the robot. He added that once remote-controlled robots are multiplied and sufficiently subtle in their operation to repair each other as well as the experimental equipment, the problem of reliability will have been essentially solved.

As to the agency which should be responsible for supporting basic research for cross-discipline type space projects, Dr. Whipple said perhaps it falls closest to the purview of the NASA. He warned, however, that NASA "is suffering from financial malnutrition because of the expected-unexpected increase in cost of conducting the experiments to which it is committed."

Dr. Van Allen urged more support for physical facilities at universities, and said that in the area of physical and mathematical sciences, to his knowledge, the National Science Foundation and the Atomic Energy Commission are the only federal agencies with a proper view of university needs. As an example of a major federal agency which does not have such a view, he cited NASA.

Project Advent Satellite

Washington—Timetable for Advanced Research Projects Agency's Project Advent active communications satellite calls for several launches during the 1962-64 period, with the program ready for operational implementation by the end of this period.

The 24 hr. synchronous-orbit ("hovering") real-time repeater satellite will operate in the microwave region, probably in the 1,000 to 2,000 mc. region. Earlier ARPA-sponsored program at Bendix for polar communications satellite equipment to operate in the ultra-high-frequency band will be dropped. Program with General Electric's Missile and Space Vehicle Department to develop the satellite itself and related stabilization probably will be continued. Defense Department has not yet approved the final joint-service management plan for Project Advent (AW May 30, p. 35), but a decision is expected shortly.

Air Force Basic Research Threatened

Washington—Basic research sponsored by the Air Force is again under siege, a situation it has faced intermittently ever since the Office for Air Research was created at Wright-Patterson AFB early in 1949.

Target of the latest troubles is the Air Force Office of Scientific Research, whose commander last week notified the next echelon above him in Air Research and Development Command that he fears "a decision has been made to curtail AFOSR's responsibilities and that a new future for it is in the planning."

Col. A. P. Gagge notified the Air Force Research Division, which is between his office and ARDC headquarters in the chain of command, that "any change in the mission, responsibilities and structure of our going organization would undoubtedly have serious repercussions at higher staff levels and with the scientific community unless such changes are backed by a comprehensive and impartial study of all factors involved."

OSR has evolved through a number of changes of title and echelon but in one form or another it has been the primary agency for USAF's sponsorship of basic research since shortly after the war.

From Fiscal 1953 until Fiscal 1958, it was spending 100% of USAF's basic research funds each year. As recently as four years ago, it was benefiting greatly from the desire of ARDC's leadership to put increasing emphasis on research, instead of investing so much of the command's resources in development that USAF would one day find itself without the fundamental knowledge necessary to handle development.

Economy Threat

By contrast, OSR was almost abolished during the Pentagon spending squeeze in the fall of 1957, before Sputnik and the strong protests of supporters of basic research, both within and outside the Air Force, brought about a reversal.

OSR's current budget of $23 million is a small fraction of the total cost of Air Force research and development work and is less than half of the figure once projected for OSR's own Fiscal 1958 budget. It is currently monitoring 1,029 research contracts, most of them with universities, individual researchers or nonprofit corporations. Since it monitors the Rand Corp. contract and some work for Defense Department's Advanced Research Projects Agency, face value of the contracts under its technical supervision is $89 million, even though its own budget is considerably smaller.

For the fiscal year beginning July 1, OSR's budget is $2 million less than the current year, its technical manpower is being reduced, the morale of its scientific personnel is lower than at any time since the difficult days of 1957, and its commander has said that if current trends are continued, they "will in the long run severely handicap the future operations of this office and compromise its future relations with the scientific community."

When the Research Division was created earlier this year as a step in ARDC's reorganization, OSR's former commander, Brig. Gen. B. G. Holzman, was named to head it. A short time later, Maj. Gen. William Canterbury was moved from deputy commander for research at ARDC headquarters into the Research Division as its commander, and Holzman was made vice commander. At that time, this move was generally interpreted as a strengthening of the division's status by giving it a two-star general instead of a one-star general as its chief.

Although OSR's percentage of USAF's basic research funds has declined from 100% through Fiscal 1957 to 66% in Fiscal 1958, 51% in Fiscal 1959 and 52% in Fiscal 1960, its current rash of troubles dates from the creation of the division.

This division now includes OSR, the Aeronautical Research Laboratory at Wright-Patterson AFB; the Electronics and Geophysics Research directorates at Hanscom Field, Mass., known as Detachment Two; and the European office of OSR, known as Detachment One.

Although many of OSR's troubles would appear to be the inevitable consequences of reorganization, civilian scientists there blame the current situation on something far more fundamental—administration by officers who do not understand basic research or appreciate its importance to the Air Force. They contend that this is the case not only at division level but is growing increasingly true of ARDC headquarters itself.

Shortly after the division was raised to two-star status, an attempt was made by the division to abolish the seven directors' positions in OSR. This was halted only after it was explained that the civilian directors were not in the military chain of command.

Manpower strength at the division level continues to increase, while manpower levels in three of the division's four subordinate offices and detachments declines or remains static. AFOSR, with an authorized strength of 88 persons, was to have remained at that level for the first quarter of the next fiscal year. The division was to increase from 111 persons authorized to 129. The research laboratory was to increase from 234 to 237, the European office was to remain at 67, and the Hanscom Field detachment was to decrease from 1,061 to 1,058.

Cause of last week's protest by Col. Gagge was notification by the division's Deputy Chief of Staff for Plans and Operations, Col. Raymond A. Gilbert, that 12 more vacant technical jobs were being removed from OSR and shifted to the division level. The last technical man in the Plans and Operations office was transferred back to OSR.

Gagge notified Gilbert that, "based on personal conversations with the commander of AFRD, this office is unaware that the decision to withdraw unfilled spaces from AFOSR was final.

"Withdrawal of those spaces," Gagge said, "indicates to this office that a decision has been made to curtail AFOSR's responsibilities and that a new future for it is in the planning." He requested that the spaces not be withdrawn "until a formal, mature and coordinated plan for the future of AFOSR is devised."

Personnel Cuts

OSR spends less than 4% of its budget on overhead, including all civilian salaries, administrative costs, etc., but not including military salaries. Approximately 20 of OSR's employes are civilian scientists and approximately 10 are military scientists. The proposed withdrawal of the 12 vacant spots involves a colonel in the office of the commander, two captains in the physical sciences directorate, a lieutenant colonel in the chemical sciences directorate, a lieutenant colonel, a captain and three civilians in the aeronautical sciences directorate, a captain and two civilians in the solid state sciences directorate and a civilian in the procurement directorate.

In addition, the procurement directorate is expected to be shifted to division level July 15. Other changes contemplated in the next few months include the transfer of Gen. Holzman to command of Detachment Two, the return of Col. Nathan Krisberg from the European office to replace Holzman, and the transfer of Col. Paul Ney to head of the European office.

OSR's budget for the past eight fiscal years has been $6 million for 1953, $6.7 million for 1954, $9.4 million for 1955, $14 million for 1956, $16.7 million for 1957, $22.4 million for 1958, $21 mil-

lion for 1959 and $23 million for the currrent fiscal year.

Both USAF Under Secretary Joseph V. Charyk and the Air Force Scientific Advisory Board are aware of some aspects of OSR's current troubles, but no over-all investigation is believed to be under way. Isolated aspects of the current situation will be reviewed or are being reviewed now by Maj. Gen. Marvin C. Demler, director of systems development of USAF headquarters; by a committee headed by ARDC Commander Lt. Gen. Bernard A. Schriever which is reviewing assignment of colonels within the command; and by a committee reviewing all military and civilian assignments in the command.

An aspect that interests OSR scientists more than most is that $7 million in Fiscal 1960 basic research contract funds, added to the regular allocation, was distributed some time ago. But OSR—which considers itself the USAF office best equipped to disburse and monitor research contract funds—received none of this.

They cite this is typical of what they consider a gross decline in ARDC's appreciation of fundamental research. If the trend is corrected, they say, USAF is certain to lose most if not all of the key members of a team of scientists that has been carefully built up.

Aerospace Corp. to Replace STL; Gardner, Partridge Named to Board

Washington — Long-delayed appearance of the new, non-profit Aerospace Corp. to replace Space Technology Laboratories, Inc., as a technical arm for USAF's Ballistic Missile Division now is expected this week.

Final details were to have been worked out late last week in a meeting between Aerospace Corp.'s board of directors and STL.

Board membership at Aerospace includes Trevor Gardner, who was USAF's assistant secretary for research and development when STL's predecessor, Ramo-Wooldridge Corp., was created; retired USAF Gen. Earl Partridge, former commander of Air Defense Command; and retired USAF Gen. James McCormack, former director of development for Air Force.

Gardner is understood to have taken a leading role in discussing the transfer of responsibilities from STL to Aerospace. Effective date was to be June 15 if details were settled by then, as expected.

Roswell L. Gilpatric, who was under secretary of USAF from 1950 to 1953, also has been mentioned as a possible member of the board, and his name has been discussed in connection with the chairmanship.

Richard E. Horner, who is about to leave the job of associate administrator of National Aeronautics and Space Administration, has declined an offer of the presidency of the corporation. He succeeded Gardner in the USAF research job.

Roger Lewis, executive vice president of Pan American World Airways, Inc., and former assistant secretary of Air Force for materiel, also is under consideration for a board membership.

The corporation has been formed to permit BMD to sever its close ties with STL, which have been the subject of considerable criticism from Congress, since STL is an independent subsidiary corporation of the Thompson Ramo Wooldridge Corp. (AW Mar. 7, p. 327). STL will continue its association with Thompson Ramo Wooldridge and is expected to assume a number of the research and development duties of the Ramo-Wooldridge Division.

Highlights of the new corporate structure and the relevant arrangements appeared to have shaped up this way:

• **Board chairman** was scheduled to make his first official visit to BMD-STL complex this week. Apparently board membership has been completed. Selection of the board apparently was one of the most difficult aspects, and was reported to have delayed considerably the implementation of the corporate plans.

• **Horner has been taking** an active part, in conjunction with BMD, in the preliminary and final arrangements for the new corporation. Others prominently associated with formation of the new arrangement include Air Research and Development Commander Lt. Gen. Bernard A. Schriever; BMD Commander Maj. Gen. Osmond J. Ritland, and Col. Samuel W. Bishop of Air Materiel Command's Ballistic Missile Center, which probably will execute and monitor contractual relationships in the new arrangement.

• **Staff functions.** Administrative services, advanced planning, and some basic research and development now done by STL will be transferred to Aerospace Corp., with STL retaining systems engineering and technical direction for Atlas, Titan and Minuteman weapon systems. It's likely that STL probably will also furnish, at USAF's request, a blueprint for guidance of the new corporation in the exercise of its staff function.

• **USAF probably will acquire** STL's facilities at the El Segundo, Calif., research and development center for use by both Aerospace Corp. and part of BMD. STL probably will acquire a new site near its present research facilities to continue its remaining contractual relationship with the USAF and begin its competitive activity in the space and missile field.

Ramo-Wooldridge work that broadly complements or is potentially competitive with STL is expected to be taken over by STL, together with associated contracts, equipment, and personnel.

This includes work now in Ramo-Wooldridge's Signal Equipment Laboratory, which covers development of communication systems, counter-counter-measures equipment, advanced antenna work, penetration systems, infrared equipment, reconnaissance systems, systems research and field service and support.

Consideration also is being given to the transfer of Ramo-Wooldridge's Research Laboratory activities to STL. This work includes programs in basic and applied research.

STL will lease space in the parent company's Canoga Park, Calif., facilities to accommodate its new activities. This will supplement facilities in Los Angeles.

Ion Engine Contract

Hughes Aircraft Co. last week was awarded a $500,000, one-year contract from National Aeronautics and Space Administration to develop and laboratory-test a cesium-fueled ion engine developing about 1/100th lb. of thrust. If the engine is successful, later models will be scaled up to ⅛th lb. of thrust and could be used with the 30-kilowatt Snap 8 nuclear power unit.

Space Surgeon Course Conducted by USAF

Cape Canaveral, Fla.—First course for military space surgeons began here last week and is expected to train 50 men a year for a tri-service pool that will be able to support Project Mercury and other manned space programs.

Thirty-eight medical instructors from the three services, civilian government agencies and industry will conduct a two-week training program under the direction of Col. George M. Knauf, Air Force Missile Test Center staff surgeon. Knauf has been training USAF medical officers for missile base work for the past several years. He is bioastronautics assistant to AFMTC Commander Maj. Gen. Leighton I. Davis in Davis' role as head of all Defense Department Mercury support operations.

FROM WAY UP THERE

PROVEN PERFORMANCE*

with Canadian Marconi Company's

DOPPLER NAVAID

ARINC VERSION

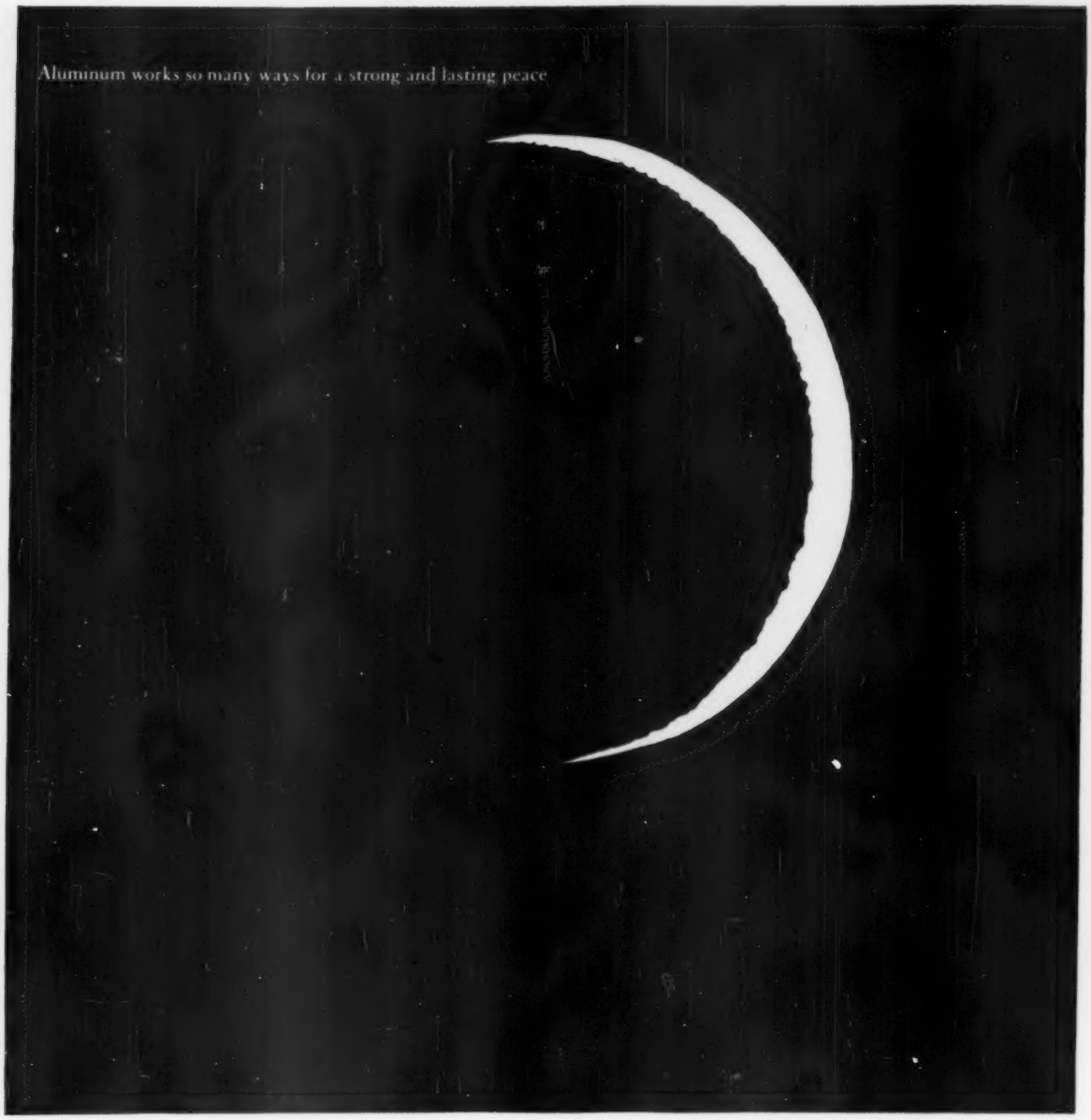
Standard production units of Canadian Marconi Company's Doppler Navaid have been proved by over 15,000 hours (4,000 jet) in routine service and ordered by:

PAN AMERICAN WORLD AIRWAYS
IRISH INTERNATIONAL AIRLINES
KLM ROYAL DUTCH AIRLINES
VARIG

*Proven Performance from 40 to 42,000 feet . . . even over *smooth* water.

For many other good reasons why you should install the Canadian Marconi Doppler Navaid, consult the *most experienced* commercial doppler manufacturer:

CANADIAN MARCONI COMPANY
AVIATION DEPARTMENT
Commercial Products Division
2442 Trenton Avenue,
Montreal 16, Canada.



Reaching for the moon?

Alcoa goes to work immediately on defense projects

Lunar, interplanetary or orbital project—Alcoa is pre-eminently qualified to be part of it. No other light-metals company has more experience. Or has invested more money or man-hours in research. Or has more modern equipment, in more plants—more savvy in developing and manufacturing new aluminum alloys. Alcoa's research and development facilities are integrated with its nationwide manufacturing complex. Regardless of how many operations are involved, each project is produced by one, individual, over-all effort. For more information, write: Aluminum Company of America, 2026-F Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

CosmicRayExperiment To Involve 14 Nations

Washington—Office of Naval Research last week launched a 500-ft. plastic balloon carrying an 800-lb. stack of photographic emulsion to record cosmic ray phenomena at altitudes up to 114,000 ft.

Analyses of recovered emulsion would provide data on interaction of cosmic rays with other particles, which could result in identification of new particles in space. Project scientists estimate that at maximum altitude the emulsion stack was being impacted 30 times an hour by primary cosmic rays.

Twenty-two universities and research institutions in 14 countries were to analyze portions of the emulsion under joint ONR-National Science Foundation sponsorship. Among these is the Polish Institute for Nuclear Research. Others are the University of Wisconsin, Washington University, University of Chicago, University of Tennessee, University of Rochester and the Naval Research Laboratory in the U.S.; Canadian National Research Council; Brazilian Center of Physical Research; Weismann Institute, Israel; Cooperative Emulsion Group of Japan; Tata Institute, India; University of Sydney, Australia; University of Bristol, England; University of Copenhagen, Denmark; Ecole Polytechnique, France; University of Hamburg, Germany; Universities of Rome, Padua, Milan and Turin in Italy, and University of Bern, Switzerland.

The gondola payload was to have been parachuted from the 10-million cu. ft. balloon near Houston, Tex., after a two-day, 850-mi. flight from the Brunswick, Ga., launch site. The timing mechanism to separate the payload apparently froze, preventing recovery on schedule. Late in the week Navy was tracking the balloon with R5D aircraft as the system drifted on a west by northwest path at altitudes varying from 114,000 ft. to 65,000 ft.

News Digest

Federal Aviation Agency's choice of a company to develop a low-cost air traffic control radar transponder for small aircraft is expected to be announced next week. Approximately 20 avionics manufacturers submitted proposals.

Aerojet-General Corp. has a $580,000 Navy contract for hybrid rocket research. Aerojet will continue a research effort already started by the Navy with hybrid systems, which combine liquid oxidizers with solid fuels.

Fiat G.91T Trainer Makes First Flight

Prototype Fiat G.91T two-seat trainer recently made its first trial flight. Flight lasted 42 min. and accomplished all test objectives, Fiat said. Ordered by Italian and West German air forces, G.91T was designed for schooling and pilot training (AW Jan. 25, p. 133).

Federal Aviation Agency RB-57, one of two turbojet bombers converted for high altitude flight checks by the agency, was abandoned in flight last week near Patuxent, Md., when horizontal stabilizer controls jammed. Two crew members bailed out, landed without injury.

De Havilland Aircraft Co., Ltd., will take over the DH 121 short-haul jet transport project from the Aircraft Manufacturing Co., Ltd., group, which includes de Havilland, Hunter Aircraft and Fairey Aviation. Since the three are in different groups in the recently reorganized British aircraft industry, they have decided to transfer the entire DH 121 project to de Havilland Aircraft.

Army-Martin Pershing test vehicle was fired on a programed erratic course from Atlantic Missile Range last week in a flight stress test. Dummy second stage was carried by the missile on its short range flight.

Radio Corp. of America was awarded a small study contract last week to determine the capability of radar and other detection devices to pick out and identify ballistic missile warheads as part of ARPA-supported Project Press, or Pacific Range Electromagnetic Signature Study (AW Apr. 11, p. 83).

Chance Vought F8U-2N crashed when it failed to gain altitude following full-fuel catapult launch at Patuxent NAS last week. The fighter crashed into a USAF H-19 helicopter awaiting takeoff, and an ambulance and a fire truck, killing four men.

North American Aviation X-15 rocket research aircraft exploded last week while undergoing runup tests of the Reaction Motors 57,000 lb. thrust XLR-99 engine at Edwards AFB, Calif. The aft section of the No. 3 aircraft, due for flight test next month, "disintegrated" and the forward section with pilot Scott Crossfield inside was thrown about 20 ft. by the force of the blast. Crossfield was unhurt. Previous engines in the X-15 have been the 16,000-lb.-thrust XLR-11-5. The No. 2 aircraft now is under modification in preparation for installation of the larger XLR-99 engine, and is scheduled for flight in September.

Capacity Issue Deadlocks Bilateral Talks

Pressure for international traffic sharing grows; U. S. aviation foreign policy changes could be a result.

By L. L. Doty

Washington—Mounting pressure on the U.S. from foreign nations for tighter control of international passenger traffic reached a critical stage last week in the wake of a complete breakdown of negotiations between the Philippines and the U.S. on a bilateral air transport agreement.

The deadlock brings into sharper focus a new controversy that threatens to draw future bilateral negotiations into similar stalemates: growing demands that the U.S. agree to restrict capacity in order to provide a more equitable share of traffic for nations with which it has bilateral agreements. The issue, which could reshape U.S. civil aviation foreign policy, is a direct outgrowth of the turbojet transport's ability to attract and absorb a major portion of available traffic in leading travel markets.

Collapse of the Philippine talks is the fourth impasse the U. S. has reached in bilateral agreement negotiations so far this year. Both the Philippines and Mexico already have tacitly suggested that, unless such capacity restrictions are imposed, U. S. operating permits to these countries may not be renewed.

Here is a brief summary of the present status of civil air relations with major foreign nations:

• **Philippines bilateral** with the U. S. expired Mar. 3 but was extended under a temporary permit until July 3. Talks between the two countries, which ended after five weeks of dispute, bogged down on the issue of capacity. Philippines insisted that capacity of aircraft operated on the transpacific route between the U. S. and Manila be controlled to prevent "unrestricted and ruinous competition" . . . that "hastens the economic doom of airlines with less favorable economic resources."

• **Negotiations with Mexico** were cut off for the same reason. Bilateral agreement with Mexico expires June 30. The capacity issue is blocking the long-sought goal of Braniff Airways to serve Mexico City.

• **Negotiations with the British** broke down last month in London following earlier unsuccessful talks in Barbados. Chief issues stalemating these sessions were the questions of extending TWA routes beyond London to the Far East and Northwest Airlines' entry into Hong Kong from Tokyo. In an attempt to soften the bitterness between the two delegations, several compromise agreements were proposed, but these were rejected by the governments of both countries.

• **Netherlands' failure** to win route concessions within the U. S. sent the Dutch delegation back to the Hague amid bitter protests against U. S. civil air policy that reached high diplomatic levels.

• **Argentine and U. S. delegations,** now meeting in Buenos Aires, have been on dead center for five weeks over capacity issues. Indications are, however, that the Argentinians are now ready to compromise on some points on which they were earlier adamant.

• **Italy and U. S.** are reviewing proposals developed in recent talks on a renewed bilateral pact. Chances are strong that an agreement will be reached.

• **Stormy sessions** are predicted when the Scandinavians and the U. S. get together in September. These negotiations may prove to be a test case over the interpretation of capacity clauses of the Bermuda agreements with respect to Fifth Freedom rights. Principles of the Bermuda Agreement, the bilateral pact negotiated by the U. S. and Britain in 1946, have served as a guide for the U. S. in all subsequent bilateral negotiations. Fifth Freedom traffic is that traffic carried by an aircraft of one country from a second country to a third.

• **Soviet Union** may accept a U. S. invitation to open talks in New York July 18 on a New York-Moscow route. Late last week, State Department had received no formal word that the Russians were ready to negotiate, although the chief of Aeroflot, Gen. Yeugeni Loginov, announced earlier this month at a press conference in Moscow that such talks would take place (AW June 6, p. 50). Meanwhile, applications for visas for 10 Aeroflot aeronautical engineers have been received by the State Department. The group is presumed to be the team which will discuss technical phases of a bilateral agreement with the Federal Aviation Agency and Pan American, the U. S. airline certificated to serve Moscow.

Survey of Competition

Washington—White House has hired United Research, Inc., to conduct a study and survey of competition between U. S. air carriers in international air transportation. Sept. 15 is the deadline for the final report, leading many observers to believe that the Administration wants the study in its hands before passing on the transpacific route case now in process at the Civil Aeronautics Board. Most significant recommendation will be whether the U. S. should serve each of its foreign routes with one carrier, a chosen instrument, or continue to operate under the present competitive principle.

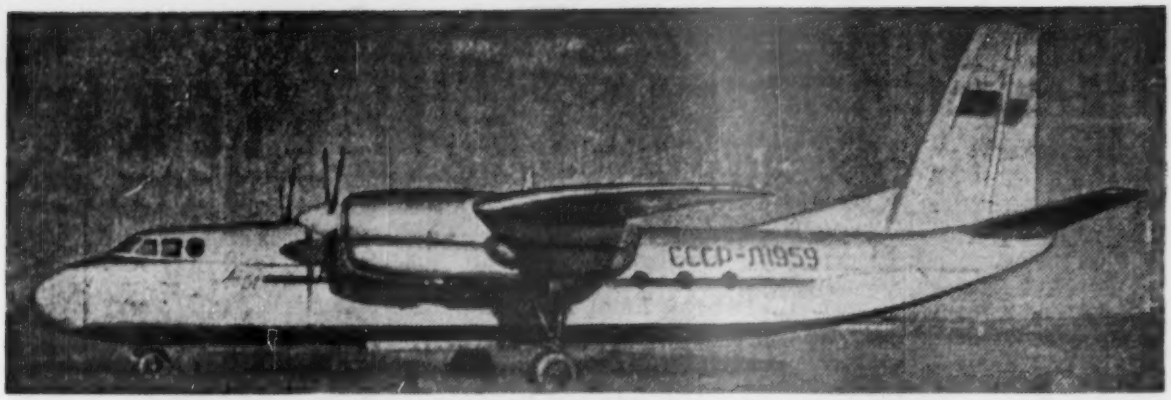
Disputed Definitions

Differences over the capacity clauses of the Bermuda Agreement are a direct result of differences in interpretation. Because of an inability of the two countries to reach firm decisions on a number of points covered in the agreement when it was first signed in 1946, the pact is not a document of refined definitions, but rather one of compromise and philosophy. Consequently, it has created widely divergent opinions on many issues involved in bilateral negotiations.

As a case in point, the second session of the recent meetings with the British was tied up for several days by attempts to resolve opposing interpretations on multiple designation, capacity clauses and paragraph IV(b) of the Bermuda Agreement which covers the addition of new cities to a carrier's routes. The arguments, which centered around the Northwest Airlines bid to enter Hong Kong, were never reconciled.

The Philippine-U. S. negotiations became so embroiled in the issue of capacity that the subject of route structure was barely touched. Essence of the Philippine demand was that an evaluation of the traffic potential on transpacific routes be set as a standard to determine the capacity of aircraft which would be operated to serve that potential.

The U.S. international airlines have taken vigorous opposition to this interpretation and have held that compe-



Soviets Reveal An-24 Configuration

First photo of the Soviet An-24 turboprop feederliner (AW June 6, p. 37) confirms new details revealed here that it is a twin-engine, 32 passenger transport with the high-wing, low slung fuselage and large, high tail fin typical of earlier designs of Oleg Antonov. This would indicate the An-24 is aimed at the same general role now being filled in the rest of the world by the Fokker-Fairchild F-27 twin-turboprop transport. The twin turboprops are rated at about 2,000 eshp. each and provide the An-24 with a cruising speed of 325 mph. at an altitude of 20,000 ft. Aeroflot claims the operating economy of the An-24 will produce ton-mile costs about 25% lower than the Il-14 piston-powered transports it is scheduled to replace. The An-24 was designed for operation over 800-1,100 mi. stage lengths and can carry 40 passengers in a high density seating arrangement for tourist class services.

tition cannot be controlled to such a degree if economical and profitable operations are to be maintained. U.S. carriers stress their point by stating they prefer to lose operating rights to these countries rather than to bow to demands for restricted capacity.

In the majority of recent cases, the State Department has upheld the carriers' position and has adhered to their interpretation of the Bermuda Agreement capacity clauses. However, how long the airlines will continue to remain inflexible in this stand once their operating permits have been canceled is still a matter of conjecture.

Also, it is quite possible that the Philippines, for example, may employ tactics designed to skirt a bilateral agreement if the U.S. continues to deny them capacity restrictions even after Pan American and Northwest are barred from serving Manila.

This was broadly hinted by Gen. Carlos F. Romulo, chairman of the Philippine delegation, when he said:

"There are other means available to the Philippines to serve the air transportation requirements of the country."

Conceivably, the Philippines, after their bilateral agreement with the U.S. has terminated on July 3, could apply to the U.S. for a foreign air carrier permit to serve Los Angeles, San Francisco and Seattle via Tokyo—the route of their choice—on a unilateral basis. In such a case, President Eisenhower, acting on advice from the Civil Aeronautics Board but with overriding powers, would make the final decision whether such a route should or should not be granted. Such action could force U.S. carriers into a position where compromise on the capacity issue would be their only alternative.

Terms of international bilateral agreements are developed without the benefit of a delineated foreign policy on civil aviation. In addition, there is no international law to serve as a guide to bilateral pacts other than agreements reached at international conferences and conventions, the most important of which are the standards set at the Chicago Convention of 1944, which defined the five freedoms which are now basic to all bilateral agreements reached outside the Soviet bloc.

Normal competition between U.S. carriers and differences of opinion among the carriers on specific issues depending on the routes they serve also have helped sidetrack the U.S. in any attempted moves toward establishing a foreign civil aviation policy. U.S. carriers have consistently fought for the right to compete freely and have bitterly contested the entry of a large number of foreign flag carriers into U.S. ports of entry and other major markets within the U.S.

In addition, domestic carriers have taken up the battle against the granting of polar routes between the West Coast and Europe on grounds that such flights tend to divert traffic from domestic transcontinental services.

Although the airlines are not members of bilateral bargaining teams, they are permitted to be represented as observers and are able to keep government negotiators advised as to their needs and requirements. The result has not been entirely satisfactory and often has caused a split between industry and government. This split, of course, stems from the airlines' role as companies out to better their competitors, contrasted to the government's role as a negotiator in the field of international relations. The two are seldom compatible, and, in air transport operations, they tend to move to opposite poles.

White House has ordered a study of U.S. international carrier competition (see box). Reportedly, the White House study is designed to bring industry policy and foreign policy into closer alignment by reshaping competition between U.S. international carriers. Presumably, the intent is to provide the U.S. with a stronger competitive front in serving travel markets abroad by consolidating divergent routes. The direct result could be the selection of a single airline as a chosen instrument on each major segment of global routes.

In recent years, air transportation has grown rapidly in importance in the economics of international trade, and most nations now view the operation of their flag carriers as a matter of concern to heads of state. This is evident in the White House study, in the stand taken by the government of the Netherlands in opposing refusal of the U.S. to grant more routes to KLM within the U.S. and, more recently, in statements by the Philippines. Gen. Romulo had this to say immediately following the breakdown of bilateral negotiations:

"It has been repeatedly emphasized . . . that we were charged with the highest responsibility by the President and the Congress of the Philippines to conclude a bilateral agreement that would be consonant with the national policy of an efficient, economically sound and responsible international air transportation system." He added:

". . . the implications of these discussions certainly will transcend the limitations of a mere air agreement between two nations."

Capital Management Fights Insurgents

Washington—Capital Airlines' management last week lashed out at the Capital Shareholders Assn. in its first attempt to thwart the employe-stockholder group from calling a special stockholders meeting to overturn the present board of directors.

At the same time, the company's management won over a second group of dissidents to its side by naming Gordon Y. Billard, New York investment banker to the board of directors. Billard is the chairman of the Capital Debenture Holders Protective Committee.

Meanwhile, the debt-ridden carrier gained a third extension in the proceedings brought against it by Vickers-Armstrongs and now has until June 27 to answer charges by the British manufacturer in a foreclosure suit.

The management group opened its fight against the Capital Shareholders Assn., representing some 2,100 employes of the company, with a letter asking stockholders "to withhold your judgment and sign nothing that will involve your company in what we think is an unnecessary, ill-advised and expensive meeting." The employes began solicitation of stockholders two weeks ago, calling for a special meeting to name a new board of directors.

The letter, which was signed by Capital's Board Chairman Thomas D. Neelands, Jr., and President David H. Baker, stated that the management "believes the calling of such a meeting would seriously hurt Capital." It promised a full statement later and concluded with "there will be ample time for you to decide what to do when you have all the facts."

Naming of Billard to the board of directors brings the board to a total of 14 members and shifts the balance of power within the board strongly behind Baker and the present management. Prior to the appointment of Neelands last month (AW May 23, p. 38), the board consisted of 12 members generally split down the middle on the question of who should run the company.

At least one attempt was made to unseat Baker from the presidency by a member of the board faction opposing the present management. Another member of this faction earlier attempted to vote Charles Murchison into the board chairmanship in a move to revamp management structure. Both attempts failed by a small margin.

Balance of power between the two board factions was seldom settled, and the sharp split between the two often caused a deadlock on issues aimed at pulling the carrier out of its financial plight. However, in the past few weeks, the group opposing Baker has been in the minority, and the present management appears to be firmly entrenched with the full backing of Neelands and members of the executive committee.

Murchison has been side-tracked, has lost the contract his law firm held with the company as legal counsel and has been removed from the executive committee, although he remains a member of the board.

Both management and the employe-stockholders group have been in touch with Vickers-Armstrongs. How successful the stockholder-employe group has been in the solicitation of proxies is still an unknown factor since the organization is prohibited by Security and Exchange Commission regulations from disclosing such information. However, there is strong evidence that the group is not unhappy over the returns thus far.

The Capital Airlines Debenture Protective Committee, headed by Billard, made substantial progress in the initial stages of its organization. It promptly met with Capital's management, with the Bankers Trust Co.—trustee for the debenture holders—with Vickers-Armstrongs and with general counsel for both Vickers and the trustee for the note-holders.

Capital's management stressed the appointment of Billard to the board in this way:

"The annual meeting of your company at which you elected a board of directors took place Apr. 20, only a few weeks ago. At that meeting, this [Capital Shareholders] Association presented no candidates and solicited no votes in opposition to the directors whom you elected. Since that time, Mr. Thomas D. Neelands, Jr., has been elected a member and chairman of the board of directors, and Mr. Gordon Billard, chairman of the Protective Committee of the 4½% Convertible Subordinated Debentures of the company, has been elected a member of the board of directors and its executive committee." It added:

"Now they [stockholder-employes] are soliciting your funds and asking for a proxy to call a special meeting to replace the board. The replacements are to be nominated by the association, whose members own an average of less than 10 shares per member, and are as yet unnamed and unknown."

Meanwhile, the Capital shareholders officials view the letter as an expression of concern on the part of management over the progress the association was making in its move to take over control of the company. The group said it has no intention of slowing down in its drive to overthrow the present board of directors, and one official emphasized to AVIATION WEEK that no member of the group has ambitions to sit on the board or top management if they are successful in changing the management.

FAA Warns Airlines On Flights Near Cuba

Washington—The Federal Aviation Agency has advised U. S. air carriers to avoid instrument flying in the area of Cuba as a result of Senate testimony on an alleged Communist conspiracy to involve U. S. aircraft in an accident.

The six carriers flying in the jurisdiction of the Havana International Airport are Delta Air Lines, National Airlines, Braniff Airways, Pan American World Airways, Pan American-Grace Airways, and Mackey Airlines.

Senate Internal Security Subcommittee heard the story from Eduardo J. Whitehouse, a Cuban national who served seven years as director of the Cuban Civil Aeronautics Administration. He was forced to leave Cuba early in 1959, shortly after the Castro regime came to power, because he was "friendly to Americans." He said that the alleged plan was to give identical instructions to two or more aircraft, and bring about a crash that could be imputed to incompetence or willful disregard of instructions on the part of a U. S. pilot. The tape record of the instruction, he said, was to be destroyed.

Whitehouse volunteered to appear before the subcommittee. His testimony was based on reports he had received from unidentified sources. He reported that there are "several well-known Communists" holding key positions in each of the four Cuban airlines—Compania Cubana de Aviacion, Aerovias "Q", Cuba Aeropostal, Expreso Aereo Interamericano—and that the Cuban Civil Aeronautics Commission "also suffers the terrible effects of the Communist hold."

He said that Communists "have created terror and total disorganization" in the Camaguey and Havana air traffic control centers.

As leaders of the alleged conspiracy to create an accident, Whitehouse named Luciano Albeo Rodriguez, president of the Air Traffic Controllers, and Cerardo Cepero, a controller at the Havana International Airport, both of whom he identified as Communists.

Whitehouse also identified as Communists the president of Air Pilots Assn., J. Triana, and the president of Cubana Airlines, Tito Hermida.

BELLY HOOK of FAA Convair C-131 engages wire pendant during tests for All American Engineering Co.'s arresting system.

Transport 'Hook' Landings Demonstrated

By Barry Tully

Georgetown, Del.—First arrested landings of a transport aircraft fitted with a belly hook were made at Sussex County Airport here by the Federal Aviation Agency. The landings were part of a project to study the feasibility of hook installations on transport aircraft.

The study contract, awarded to All American Engineering Co., Wilmington, Del., called for 20 arrested landings with an FAA Convair C-131. The 20 landings were completed, along with one failure to snag the cross-runway pendant. The "miss" was the first attempt before a demonstration audience after 16 previous successful engagements. Following the hook skip incident, four successful arrestments were demonstrated.

Moderate Force

This observer, riding in the rearward facing seats of the Convair, experienced only slight deceleration forces as the aircraft rolled out 1,350 ft. after engaging the ¾ in. wire pendant. Deceleration forces appeared comparable to a sudden application of reverse pitch thrust in a propeller aircraft and were considerably less severe than those experienced on an aircraft carrier landing. The average speed on engaging the pendant was 90 kt. Aircraft weight during the tests was about 40,000 lb.

All American Engineering is attempting to interest the air transport industry in its emergency arresting gear now in operation at military air fields. Another company in the arresting gear business is the E. W. Bliss Co., Canton, Ohio.

The Wilmington concern designed the hook for the twin-engine Convair and the arrestments were made at the company's test facility here.

The arresting gear, the company's Model 340-D water squeezer type, employs a loose fitting piston which is pulled through a tapered, fluid-filled tube to decelerate the aircraft. The arresting gear is designed to provide a constant runout of 1,350 ft., thus spreading the deceleration over the longest time interval.

Advocates of an emergency runway arresting system say it would provide added safety in the event of aborted takeoffs, brake failures on landing, long landings on slippery runway surfaces and other runway overrun situations. There is, however, considerable opposition to the installation of arresting hooks on transport aircraft. Among the objections are the expense, the weight penalty and the possible adverse psychological effects on air travelers.

If a reliable arresting system could be developed which would engage the main gear of all transport aircraft, the weight penalty, expense and fear aspect could be dispensed with along with the hook. Varying geometry of tricycle landing gear and the necessity to arrest propeller as well as jet aircraft has stymied attempts to develop a reliable engaging system. The high miss percentages with runway barriers led to the installation of belly hooks on Air Force Century series fighters. FAA studies also indicate that for reliability, the hook is the thing.

Hook Modified

The hook employed on the FAA Convair is a modified version of the one designed for the Navy Douglas AD attack aircraft. Modification included extending the hook 18 in. to a length of about 8 ft. The hook is fitted to the underside of the fuselage and structurally tied to the keel of the aircraft. The hook is raised and held in the up position by hydraulic pressure and forced down upon release of pressure by compressed air dashpots. The weight of the entire hook assembly is 130 lb.

All American has designed a flat spring steel emergency arresting hook for the Convair F-106 fighter. This

LOCKHEED JETSTAR
DOES EVERYTHING
THE BIG JETS DO
(yet lets you set the schedule!)

AND PRATT & WHITNEY
AIRCRAFT JET ENGINES
HELP MAKE IT POSSIBLE

YOU say where and when—and the new Lockheed JetStar flies you there with jetliner speed, comfort, quiet and reliability. It has intercontinental capabilities, yet can land at smaller airports. Four Pratt & Whitney Aircraft JT12 engines power the JetStar. Each weighs only 436 pounds but develops 3,000 pounds thrust—one of the most efficient and reliable powerplants ever developed. Its simple, rugged design insures easy maintenance and high operational reliability. Backed by Pratt & Whitney Aircraft's world-wide service, the JT12 is an engine conceived, designed and built for business use. It's one of the reasons why so many leading firms in the U. S., Canada and Europe have already ordered Lockheed JetStars.

PRATT & WHITNEY AIRCRAFT
East Hartford, Connecticut
A DIVISION OF UNITED AIRCRAFT CORPORATION

hook is mounted flush to the belly of the fighter so that only the hook point offers resistance to the airstream. In an emergency situation, a solenoid locking mechanism releases the hook point and the hook springs to the down position. The hook, upon contacting the runway, is forced against the runway surface by pressure of the spring steel, facilitating engagement of the cross-runway pendant.

An installation of this spring steel hook on the Convair would weigh 80 lb., according to All American.

The company has designed a water squeezer type arresting system for transport aircraft weighing between 100,000 and 300,000 lb. This system, Model 3000-1000 has never been built. However, All American has proposed installing this system for test purposes at Dulles International Airport, Chantilly, Va. In conjunction with this proposal to the FAA, the company has proposed the installation of one of its spring steel hooks on a Boeing KC-135 which the FAA is scheduled to receive on bailment from the Air Force.

The FAA, while studying these latest proposals, is testing a landing gear engagement system at its National Aviation Facilities Experimental Center at Atlantic City, N. J. The tests are of a pop-up system, triggered by the nose wheel, to engage the main landing gear. Results of the tests, which involve various landing gear configurations, have not been announced.

FAA Threatens to Suspend Pilots In Dispute Over Flight Inspectors

Washington—Federal Aviation Agency threatened airline pilots with suspension last week for refusing to allow FAA inspectors to conduct routine inspections in jet transports from the jump seat behind the pilot.

FAA took the action after Eastern Air Lines pilots had forced cancellation of several flights because pilots refused to take off with an FAA inspector in the seat normally occupied by the third pilot, who flies in Eastern's DC-8 cockpits under terms of the airline's contract with the Air Line Pilots Assn.

Eastern obtained a U.S. District Court temporary restraining order requiring ALPA and its Master Executive Council in Miami to rescind instructions issued which would interfere with flight operations.

FAA Administrator E. R. Quesada said last week that the authority of the agency had been "arrogantly challenged" by pilots refusing to submit to "routine" inspections. He announced that FAA had issued a special Civil Air Regulation specifying that all carriers make available ". . . a seat on the flight deck of each aircraft . . ." for inspectors.

The special regulation also specifies that in certain turbojet aircraft having more than one observer seat, the inspector will sit in the seat directly behind the pilot.

ALPA said FAA appeared to be "mistakenly injecting itself into a legal problem between two private parties." The union said pilots welcome proper inspection, but they object to having crew members displaced. ALPA defended the pilot's action in refusing to fly the jet aircraft without the third pilot in the seat behind the pilot.

Quesada said that pilots who refuse to submit to routine inspections would be considered unfit to fly aircraft and would have their certificates suspended until they do submit to the inspections. In the Eastern dispute, the pilot of one DC-8, who canceled his flight by refusing to fly, later submitted to an inspection.

Quesada said the removal of the third pilot from the seat directly behind the captain to permit the seating of an FAA inspector would not impair the safety of the aircraft in flight. He said the DC-8 was certificated for a pilot and a copilot and that any agreement between ALPA and a company was their business and the agency was not an interested party.

Quesada said the FAA conducts the routine inspections on a nonscheduled basis and checks about 1% of the scheduled flights made in any given period. He added that the agency has a legal right to conduct these inspections and as far as he is concerned, the inspector will sit in the most advantageous seat to conduct inspection.

A meeting was scheduled between FAA and ALPA officials to discuss the seating issue, but before it was held, ALPA informed the agency it had taken its own action and advised its members not to take off if the seat behind the pilot was occupied by an inspector.

Helicopter Carriers File Financial Reports

Washington—Trends in operating income and costs are shown in first quarter results filed with the Civil Aeronautics Board by Chicago Helicopter Airways, Los Angeles Airways and New York Airways.

First quarter financial results show that Chicago Helicopter Airways, operating a mixed fleet of three Bell B-47 helicopters and seven Sikorsky S-58s, had a lower breakeven subsidy need on a revenue ton mile basis than either of the other helicopter airlines. Los Angeles Airways is operating a fleet of five Sikorsky S-55s and New York Airways has five Vertol V-44Bs.

Based on reported revenue ton miles of 108,730 CHA has a breakeven need of $3.37 per revenue ton mile, compared with LAA's $5.15 on 48,726 revenue ton miles and NYA's $8.45 based on 67,298 revenue ton miles. In the same three month period, the Chicago airline earned total ton mile revenues of $6.59, including subsidy payment of $3.

LAA produced a revenue rate of $7.36 with subsidy of $4.70 and NYA's earnings per revenue ton mile were $11.82, including subsidy of $8.08.

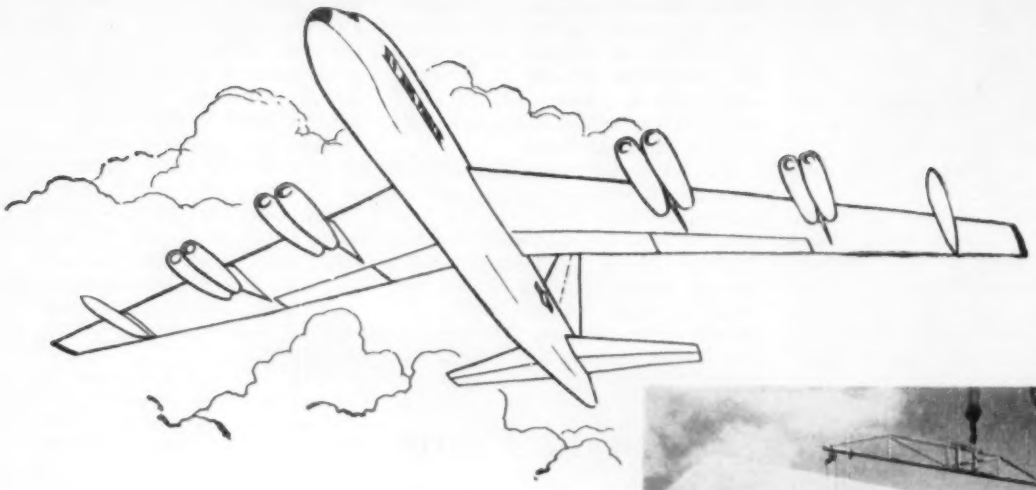
Total direct expenses per revenue ton mile, including flying operations, direct maintenance and depreciation, were $4.14 for CHA, $3.40 for LAA and $6.62 for NYA. Total indirect expenses for the three carriers were listed as $2.74, $3.66 and $5.38, respectively.

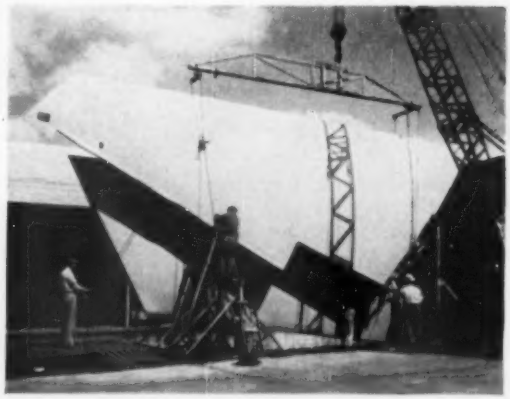
A breakdown of direct operating expenses by types of equipment on an aircraft mile basis shows total direct expenses for CHA's 12 passenger S-58 of $2.22. The five passenger S-55s flown by LAA had expenses of $1.08 and NYA's 14 passenger V-44Bs had a total direct operating expense of $3.97 per aircraft mile. The figures include combined flying operations and maintenance expenses of $1.71 for the S-58, 99 cents for the S-55 and $3 for the V-44B, based on total aircraft miles of 181,686, 153,908 and 111,828.

Daily utilization rate for CHA's S-58s was 3 hr. 18 min., compared with 4 hr. 41 min. for the S-55 and 4 hr. for the NYA Vertols. Revenue passenger load factors realized during the first quarter were 53.3% for the S-58; 54.1% for the S-55 and 46.6% for the V-44B.

Total revenue ton miles recorded by Chicago Helicopter Airways increased 112.4% to 108,730 in the first period of this year compared with the same period of 1959. Gains of 11.5% to 48,726 revenue ton miles were listed by LAA and NYA's revenue ton miles increased 37.1% to 67,298.

CHA's non-mail revenues increased 35.5 cents to $3.52 per revenue ton mile for the first quarter over the same period last year, while total operating expenses decreased by $3.62 from a 1959 figure of $10.51. In the same period, LAA increased non-mail revenues by 41.5 cents to $1.50 per ton mile, but registered a 20 cent gain in total operating expenses to $7.06 per ton mile. NYA's non-mail revenues decreased 37.7 cents in this period to $3.55, while total operating expenses decreased $3.24 to $12.00 per revenue ton mile.





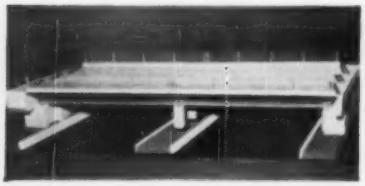
FAIRCHILD

for low cost production

of high quality complex assemblies

The Fairchild Aircraft & Missiles Division's design and construction capabilities were acquired through long experience in successfully completing varied projects for industry. Just one of the many areas where Fairchild's proved abilities are at work is the production of major assemblies for the Boeing B-52 intercontinental jet bomber. Fairchild utilizes its diverse experience in bonding, plastics and metals to construct honeycomb sandwich wing panels, magnesium laminated wing skins, tapered honeycomb trailing edges and honeycomb wheel and strut doors – many to critical tolerances.

Fairchild's broad facilities, its modern equipment and personnel experienced in the on-time design and fabrication of systems, subassemblies and products, are available to you. Write today for detailed information.



Representative of Fairchild's diverse production capabilities are: VTOL/STOL projects • High flotation gear • Boeing B-52 assemblies • SD-5 surveillance system • Antenna and installation housing for radar • F-27 propjet • Aluminum boats, lampposts and bridges.

FAIRCHILD AIRCRAFT & MISSILES DIVISION
Fairchild Engine & Airplane Corp. • Hagerstown, Maryland

Surface-Mail-by-Air Program Attacked

By Ford Eastman

Washington—Rep. Glenn Cunningham (R.-Neb.) attacked the first class mail airlift program last week charging that the Postmaster General has no legislative authority to expand the airlifting of first class mail and warning that "it must be stopped promptly." Railroads backed his stand.

Rep. Cunningham, a member of the House Post Office and Civil Service Committee, testified before that group's Post Office Operations Subcommittee in support of legislation he introduced to prohibit the movement of mail by air unless it carries airmail postage.

He said expansion of the Post Office program is "clearly in opposition to the intent of Congress" and that it would have an adverse effect on the railroads. Movement of mail by air under the experimental plan, he said, has shown that delivery has not been expedited, that it cost the Post Office Department more money and that users have been discriminated against.

Cunningham's remarks were in direct contrast to the stand taken by the Senate Post Office Subcommittee headed by Sen. A. S. Mike Monroney (D.-Okla.). Last August, the subcommittee concluded, "after careful study," that the Postmaster General does have the authority to transport all classes of mail by air to the extent required by the postal service at rates fixed by the Civil Aeronautics Board.

Rep. Ralph J. Rivers (D.-Alaska) appeared before the House group in opposition to the Cunningham bill, maintaining the measure is a "step backward in a rapidly moving modern age." He said mail moving by boat from Seattle to Alaska involves a trip ranging from 900 to 1,800 mi. and takes from 10 to 15 days. Air transportation is a necessity, he said.

Rep. Daniel K. Inouye (D.-Hawaii) also protested the Cunningham bill on the grounds that a similar situation exists with mail moving between Hawaii and the mainland. Regular first class mail from Washington to Honolulu requires an average of eight to 14 days, he said.

Cunningham admitted that the situation with offshore points is different from domestic mail service and said that the subcommittee would consider amendments if the bill is reported out.

Witnesses representing railroad groups were unanimous in their support of the Cunningham bill, claiming its approval is necessary to ensure the survival of railroads.

Herbert B. Brand, director, Railway Mail Transportation Division, Association of American Railroads, gave these reasons for supporting the legislation:

- **"H. R. 10196** (a bill which is identical to the Cunningham bill) and the other similar bills requiring users of the mails to pay airmail postage for air service simply recognizes and preserves the economic concept that one should pay for service received.
- **"The air lift plan** is said to be responsive to public demand, but, except as to offshore points of Hawaii, Alaska and Puerto Rico, which clearly present a unique situation, there is no evidence of such demand. The absence of such evidence warrants the conclusion that the public is satisfied with the distinction between surface and airmail which has been in effect for years.
- **"The Postmaster General's** air lift plan, the basis of his opposition to this bill, involves the movement by air of first class mail only and only between high-density populated areas. The Postmaster General has attempted to justify the air lift plan on the ground that it has been made necessary by the discontinuance of passenger trains. Yet it is between the very areas where the best facilities for such transportation are and will be available that the Postmaster General proposes to fly the first class mail.
- **"The air lift plan,** touching as it does only the principal metropolitan areas, could not—even if it worked—result in anything but the rankest sort of discrimination against thousands of communities which would not enjoy its direct 'advantages.' How could such a situation be thought to be in the public interest?
- **"In truth,** the Postmaster General's air lift plan is not a 'plan' at all. It contains no assurance of anything. It is on a voluntary, space available basis and any airline participating in it can withdraw on 30 days notice. In addition, first class mail will receive no priority and will be accommodated only after passengers, airmail, express, baggage and air freight have been loaded. This introduces an element of uncertainty wholly at odds with the reputation of the U. S. Post Office for regularity and dependability.
- **"Officials of the** Post Office Department have at various times asserted that the air lift program could be carried on at no greater cost to the Department than moving the same mail by surface means. However, a state of complete confusion appears to exist with respect to what the cost of the air-lift program is and will be and how it will affect the postal deficit. This confusion probably results from the fact that necessary data to determine the actual cost of the program simply is not available."

Fred Carpi, vice president-sales for the Pennsylvania Railroad Co., claimed that all eastern railroads are united in their support of the Cunningham bill and that all will suffer the same "disastrous effects" if the measure is not enacted.

Carpi said if plans of the Post Office Department to divert large portions of first class mail from the railroads are carried out, "the decline in railroad passenger facilities will be accelerated at a rate which has never before been seen in this country." Enactment of the Cunningham bill, he said, would help prevent an accelerated decline in railroad passenger service, avoid an increase in Post Office costs and provide for the maintenance of economic mail transportation service for all the people on equal terms.

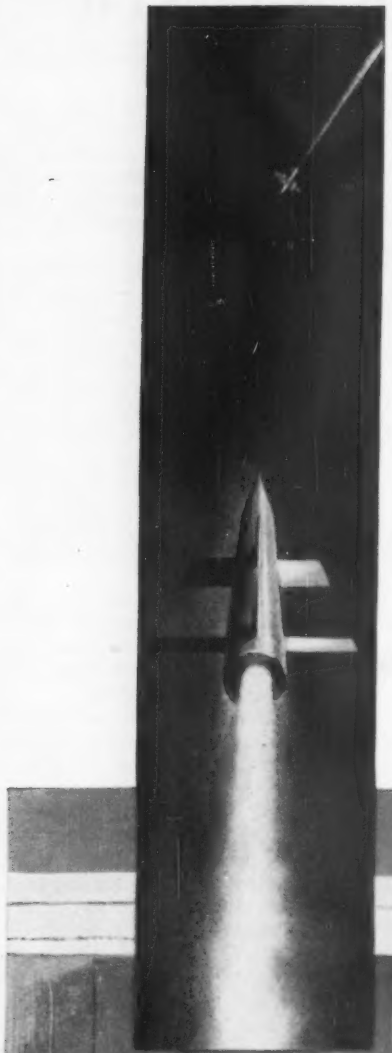
James R. Getty, Seaboard Air Line Railroad Co. general passenger traffic manager, also told the subcommittee that loss of mail revenue would threaten curtailment of railroad service.

"Mail revenues are a very substantial portion of our total passenger train earnings and contribute more than a nominal share of justification for the operation of some of our passenger trains," he said. ". . . Should we lose the railway post office revenue, which comprises approximately one-third of our mail service pay, a review of the earning statements of the trains would be mandatory, and the results in all probability would necessitate having to seek permission to withdraw some trains."

Charles E. Keif, vice grand president of the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employes, warned that railroads might require subsidy in order to maintain an adequate rail system for national defense if the railroads lose surface mail pay.

"We are sure that Congress is fully cognizant of the fact that not only during these troubled times, but for all times, an adequate national railroad transportation system must be maintained regardless of the cost thereof," he said, "and by the continued retention and transportation of first-class mail at first-class rates on the surface may prevent the subsidization of an adequate national rail transportation system for our national defense."

Scheduled to testify in opposition to the Cunningham bill late last week were the Air Transport Assn., the Association of Local Transport Airlines, the Post Office Department and representatives of individual airlines.



THE SUCCESS OF THE SEASLUG TODAY...

...MEANS BETTER WEAPONS FOR DEFENCE TOMORROW

The vast research and development facilities of Seaslug's main contractors—Armstrong Whitworth Aircraft, G.E.C. and Sperry Gyroscope Co.—are constantly being used to improve the performance of this ship-to-air missile system. Already Seaslug is established as the most accurate weapon in its class. Several hundred missiles have been fired with outstanding success from both land and ship-borne installations. But, in this new branch of aviation, nothing stands still. The development of ship-borne weapon systems is a highly specialised business, calling for vast experience.
The know-how obtained by the three principal contractors guarantees the success of even more formidable defensive weapons in the future.

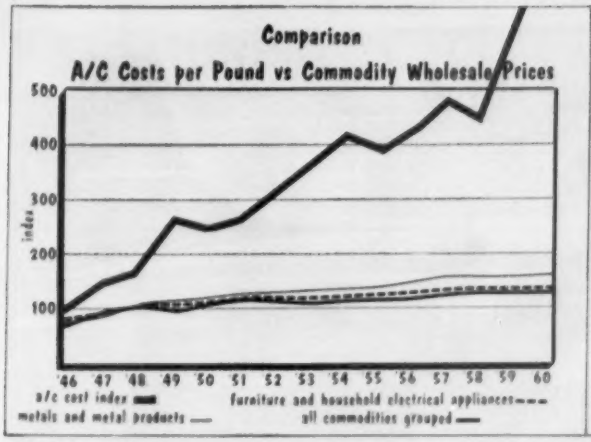
SEASLUG

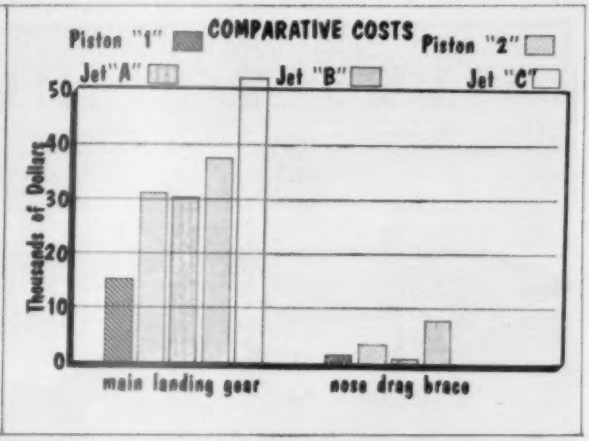
Designed and Manufactured by:

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD. (a member of Hawker Siddeley)

THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

SPERRY GYROSCOPE CO. LTD. OF ENGLAND





AIRCRAFT COSTS per pound are compared in chart at left with wholesale prices of metals and metal products, and furniture and household electrical appliances. Chart at right shows comparative costs of different piston-engine and jet aircraft components.

TWA Scores Jet Airliner Parts Pricing

By David H. Hoffman

Kansas City, Mo.—Jet aircraft parts prices are often excessive and arbitrary, bearing little relation to value or suppliers' production costs, Trans World Airlines top management told representatives of 50 suppliers and airlines here.

As the military services shift their budgetary attention to unmanned aircraft and space vehicles, TWA speakers emphasized, the airlines assume increasing importance as consumers of components and merit correspondingly better service from their vendors.

J. A. Shaunty, director of technical purchasing for TWA, warned the airline support symposium that those manufacturers who persist in treating the air carrier industry "as the 2% tail of a 98% customer" will find their flow of orders for parts and supplies suddenly stopped.

Halting the upward spiral of component costs will free airline capital for investment in new jet transports, said Ray M. Dunn, TWA's vice president for technical services who opened the conference for 152 representatives of the manufacturing and airline industries. Reduced material costs, which now consume 60% of the airline's revenue, will make possible the fare reductions needed to bring air travel within reach of low income brackets. This, in turn, will increase the demand for parts and supplies as carriers expand their air fleets to accommodate what is currently a vast but untapped market, Dunn predicted.

Specifically, TWA charged that prominent vendors, besides over-pricing, at times were guilty of:

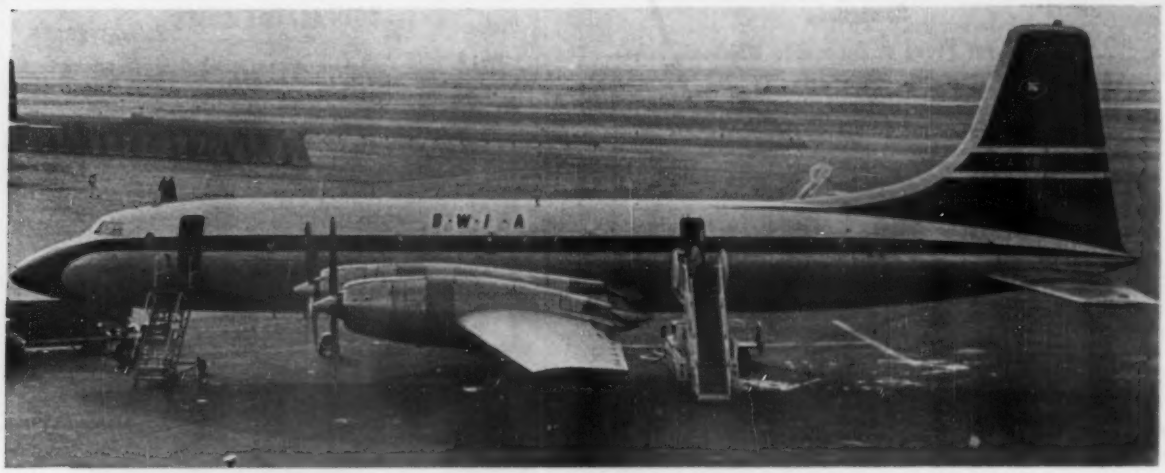
- **Furnishing new products** without adequate maintenance, overhaul and training data to guide the carriers in their usage.
- **Refusing to supply** piece replacement parts, thereby forcing the airlines to replace items that should be repaired for maximum economy.
- **Failing to keep adequate** inventories in anticipation of future sales so that lead times on airline part orders commonly range from 30 to 180 days.
- **Farming out subcontracts** on rotable components without determining which firm available would do the job for the lowest price.
- **Neglecting to standardize** parts that should be interchangeable on aircraft of the same series.
- **Ignoring the reliability** record of a given component used and maintained by more than one airline. Auditing the performance of a troublesome part in the field often would uncover improper usage or maintenance procedures and thus eliminate the necessity for costly design changes, TWA said.

Taken together, such shortcomings are lessening the inherent productivity of the jet transport. TWA's original estimate was that the Boeing 707 would return four times more in revenue than a modern piston-driven airliner while costing about twice as much.

But in actual practice, according to Dunn, the turbojet is costing about

TWA Inventory Breakdown

	Before Jet 12-31-58	After Jet 12-31-59
Expendable items (84,000 types)		
Repair parts	$ 12,333,400	$ 12,482,400
Passenger service	287,600	320,100
Raw materials	1,229,300	1,467,467
	$ 13,850,300	$ 14,269,967
Rotables—Repair and reuse (8,000 types)		
Engines and power pack	$ 18,237,000	$ 27,880,800
Propeller	2,008,000	1,837,400
Radio	2,580,000	2,721,200
Accessories	14,158,900	16,883,800
	$ 36,983,900	$ 49,323,200
Miscellaneous		
Pipeline-issued	$ 7,215,300	$ 8,053,100
Totals	$ 58,049,500	$ 71,646,267
Aircraft value	254,419,800	332,137,300
Per cent inventory investment to fleet investment	23%	22%
Fleet	197 aircraft 11 types	193 aircraft 12 types



BWIA Operates Britannias Under Charter From BOAC

British West Indian Airways is operating two Bristol Britannia turboprop transports on its routes between London-New York-Barbados-Trinidad, and London-New York-Jamaica. Both services are flown once a week. The Britannias are chartered from British Overseas Airways Corp. and are operated by BOAC crews. The letters "BWIA" on the fuselage cover the original BOAC markings, and are removed when the aircraft are turned over to BOAC after flying the BWIA routes each week.

three times as much to purchase, operate and maintain and producing only three and one-half times the revenue earned by its piston-driven predecessors. And even this margin is narrowing, Dunn said.

S. L. Higginbottom, assistant vice president-engineering, flight test and inspection at TWA, urged that the manufacturers, in addition to auditing their hardware's performance more attentively, consult with airline engineering staffs in solving product problems. A constant flow of ideas between vendor and user effectively would double the two parties' engineering talent and provide the manufacturers with a large in-service testing laboratory, he said.

To illustrate the important role parts play in an airline budget, Shaunty contrasted TWA's 1940 inventory and fleet with 1960. He said that in these two decades the value of parts issued each month rose from $130,000 to $2,200,000. TWA's fleet, meanwhile, grew from 39 aircraft of two types to 193 aircraft of 11 types.

In 1940, the carrier had $800,000 tied up in its inventory of expendable parts and $900,000 invested in rotables. Comparable 1960 figures are $14 million and $50 million. Total types of expendable items stocked jumped from 14,000 to 84,000 in the 20 year period.

Historically, Shaunty said, TWA has spent 18.7% of fleet cost in provisioning spare parts.

By forecasting airline parts requirements, producing in economical quantities and increasing their own inventories, component manufacturers could save TWA up to $2.75 million each month, Shaunty said. Because the gross profit realized on a Boeing 707 amounts to 25%, he said, 25% also must be charged as cost on the airlines' investment in parts inventories, which represent capital that otherwise could be used to purchase productive aircraft.

TWA would be glad to pay a portion of this 25% for interest and overhead to manufacturers willing to establish parts stockpiles, said Shaunty.

Fred G. Betts, TWA vice president-purchasing, cited one instance in which the company, feeling that the prices quoted by vendors on a series of components were too high, sent the components specifications out to the industry for bids. Contractors' responses in every case listed far lower prices than those quoted by the original vendors.

Betts said that in follow-up queries TWA learned that these contractors had not been approached by the vendors in question.

In some cases, Betts said, prices were fixed before production had begun and no effort was made to adjust them to actual costs once these were determined.

TWA dramatized the wide variations in price for similar aircraft components by staging an airline version of "The Price Is Right" television program. Five sets of six panelists identified by name but not by company were chosen from the audience and asked to guess the prices of look-alike components displayed by a group of hostesses. Their strikingly wrong estimates were then corrected by TWA, which disclosed that:

- **Two wingtips,** one left and one right, made by the same vendor for the same aircraft were priced at $159 on the left side and $1,420.05 on the right side.
- **Engine mount bolt,** a main landing gear bolt and a rib attachment bolt, all of which appeared interchangeable, were priced respectively at $.81, $1.70 and $71.90.
- **Two landing lights** of comparable size and candlepower were priced at $36.50 and $336.
- **Three toilet seats,** two entirely white and one two-toned pink and white, were priced at $5.72, $9.70 and $122.
- **Two sensor units** built to perform the same task were priced at $2,556 and $395.

Appeals Court Backs CAB's Delta Ruling

Washington—U. S. Court of Appeals last week upheld a Civil Aeronautics Board decision that Delta Air Lines owes the government some $2.5 million paid in subsidy to Chicago & Southern Airlines before the carrier was merged with Delta in 1952.

CAB ruled last year that Delta owed the government $729,000 as an "offset" of profits from C&S's domestic operations against losses incurred in the carrier's international operations which were covered by federal subsidy. The offset principle was first developed by the Post Office Department, later was upheld by the Supreme Court.

In addition to the $729,000 due, the Board decided that $1 million representing excess payments to C&S should be repaid by Delta. Income tax adjustments could force the total amount to close to $2.5 million.

Delta is expected to file for reconsideration.

SHORTLINES

▶ **Civil Aeronautics Board** will reopen the Large Irregular Air Carrier Investigation June 14 with a hearing to consider the qualifications of Airline Transport Carrier, Inc., Argonaut Airways Corp., Miami Airline, Inc., and World Wide Airlines, Inc., to perform supplemental air transportation.

▶ **KLM Royal Dutch Airlines** is flying the entire cast of the touring company of the Broadway show "My Fair Lady" and most of its stage equipment from Moscow to Washington, D. C. via Amsterdam. The airlift will use five freighters and one passenger transport.

▶ **Laurentide Aviation, Ltd.,** of Canada has been granted a temporary foreign air carrier permit for three years to provide air transportation from Montreal to several states in the U. S. on an infrequent basis.

▶ **New York Airways** application to initiate routes to Patterson, N. J., from La Guardia Airport and to Freedomland Park in the Bronx Borough of New York from New York metropolitan airports, Stamford, Corn., and Manhattan has been disapproved by CAB. In its order, the Board said forecasts submitted by NYA of the financial results of the two services have not been subjected to complete analysis by the Board to determine the ultimate effect on the carrier's subsidy need.

▶ **Pan American World Airways'** proposal for an increased thrift class fare from New York to Puerto Rico has been further suspended by the Civil Aeronautics Board. The Board extended the tariff suspension from June 12 through Sept. 10, pending a decision in the Puerto Rico Fare Investigation. Pan American would have increased thrift fares from $45 to $52 one way on the New York-San Juan route. The Board also is reviewing a proposal by Eastern Air Lines which would call for a 5% fare increase plus $1 for each one way ticket over the same route effective July 7.

▶ **Port of New York Authority** and department of Marine and Aviation of the City of New York have approved plans to build a $165,000 public heliport on the East River, just north of the Battery on lower Manhattan.

▶ **United Air Lines** reports it carried 500,000 passengers 723,300,000 passenger miles in its fleet of Douglas DC-8 turbojet airliners in the first eight months of operation, ending May 31.

AIRLINE OBSERVER

▶ Trunkline traffic continued to increase during May, but growing jet competition on major routes is beginning to deflate unusually high load factors experienced last year on turbojet flights. In the Washington-Baltimore-San Francisco nonstop market, where United and TWA are in close competition, chances are strong that at least one turbojet flight will be pulled this month by one of the two carriers because of dwindling load factors.

▶ **Seven passengers have been charged by the Federal Aviation Agency with violating a regulation which prohibits passengers from drinking from private liquor supplies in flight. Incident occurred aboard an Eastern Air Lines' Lockheed Electra flight en route from New York to Montreal. According to the FAA, the seven U. S. passengers, along with an eighth Canadian passenger, refused to take their seats when the seat-belt sign was flashed on and ". . . turned the passenger cabin into a littered shambles." Their action also brought threats of an emergency landing from the captain. Persons involved have been advised they are subject to civil penalties not to exceed $1,000 under a regulation adopted by the agency in March.**

▶ Trans-Caribbean Airways and Resort Airlines will sign an agreement calling for a transfer of Resort's operating certificate to Trans-Caribbean. The plan, subject to Civil Aeronautics Board approval, was arranged because of Resort's inability to obtain landing rights in certain Caribbean airports and because of the unsettled political situation in Cuba. As an interim measure pending final approval of the agreement, Resort has petitioned the CAB for permission to suspend service until Dec. 11.

▶ **Russia's Aeroflot is planning to inaugurate jet or turboprop services on 24 additional routes this month. New twin-engine Tu-104 turbojet flights include: Kiev-Khabarovsk, Sverdlovsk-Tbilisi and Kiev-Simferopol. Il-18 turboprop transports are scheduled to go into operation between Novosibirsk and Alma-Ata, Tashkent-Adler, Riga-Moscow, Leningrad-Baku and Ashkhabad-Simferopol. Two international routes will also be served by Il-18s: Moscow-Warsaw and Moscow-Kabul. Il-18s and Tu-104s are apparently taking over some of the routes originally planned for the An-10. New An-10 flights aren't being mentioned for any of the new scheduled services.**

▶ Federal Aviation Agency will conduct a research program designed to obtain medical data on stress and fatigue factors in working conditions of air traffic controllers. The study will provide information on mental resilience and physical stamina of controllers under normal control situations as a means of drawing guidelines for working conditions, retirement policies and hours of employment, including shift rotations.

▶ **Eastern Air Lines' long-range equipment program now includes the Boeing 727 tri-turbojet-engine transport for medium-range routes and the Fairchild F-27E turboprop transport as a replacement for Martin 404s and Convair 340s. Full appraisal of the two aircraft by Eastern is well under way.**

▶ Delta Air Lines has purchased three Convair 880 turbojet transports in addition to the initial 10 ordered for delivery this year. Three new airplanes will be delivered in the late summer of 1961. Delta lost one of its first 880s in a training accident (AW May 30, p. 39).

▶ **Russian designer S. V. Ilyushin and his chief aides in developing the Il-18 turboprop transport have been awarded the 1960 Lenin Prizes in engineering. Sharing the honor with Ilyushin are A. G. Ivchenko, designer of the Il-18s' engines, Test Pilot V. K. Kokkinaki and Chief Designers V. A. Borog, V. M. Germanov, A. N. Zlenko, A. Ya. Levin, V. A. Lotarevm, A. K. Panteleev, E. I. Sankov, V. N. Semenov and A. I. Shvedchenko.**

▶ Bills introduced in Congress this year designed to eliminate subsidy payments to trunkline carriers are not expected to be passed this session. Two such bills have been introduced in the House, one in the Senate.

▶ **Defense Department will transfer about 5,000 tons of military ordinary mail each year to all-cargo commercial flights between the U. S. and Europe and within Europe. The mail, which previously was handled by military airlift, will be carried at 27.3 cents per ton-mile, half the rate paid for airmail.**

TRANS-CANADA AIR LINES has ordered three more Vanguards. This raises their total order to 23.

TCA President, Mr. Gordon McGregor said, "The most exhaustive studies by TCA's engineers have convinced me that the Vanguard will be the finest aircraft of its class in the 1960's, with exceptional passenger appeal and extremely low operating costs."

Mr. McGregor's confidence is well placed. The Vanguard goes to TCA with all the engineering experience and more than 2,500,000 Viscount turbo-prop hours "built in" its design. It is *the world's only second generation turbo-prop airliner.*

Big, roomy and comfortable, the Vanguard is built to pace the jets. In fact, this four-engine turbo-prop can generally show a better "block time" on short to medium haul routes than comparable pure-jets—

NEWEST FROM THE WORLD LEADER IN JET-PROP AIRCRAFT . . .
POWERED BY FOUR ROLLS-ROYCE TYNE ENGINES

AIR LINES ORDERS VICKERS VANGUARDS

and is far more economical and flexible. TCA intends to operate its Vanguards on medium range routes in North America and the West Indies. Each will carry 100 passengers in modern luxury, *plus* four and a half tons of freight.

The Vanguard's cargo capacity is another notable feature of this outstanding plane. Its two huge holds can accommodate up to ten tons of freight, so that with only 30 passengers aboard, the Vanguard can still make a handsome profit as a freighter.

We congratulate Trans-Canada Air Lines on their choice of the Vanguard. Planned to produce high operating profits, this newest of the turbo-props is the most advanced airliner ever designed for economical operation. For further details contact Christopher Clarkson, 10 Rockefeller Plaza, New York 20, N. Y.

VICKERS

VANGUARD

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. • WETBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP

Airline Income & Expenses--1st Quarter, 1960

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Property[2]	Charter	Federal Subsidy	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	84,015,049	1,941,578	7,861,289	64,625	.....	94,270,998	95,649,636	−1,640,186
Braniff	15,601,178	443,221	852,239	48,659	.....	17,023,287	17,459,666	−608,543
Capital	21,901,993	562,818	952,114	2,863	.....	23,586,412	28,409,922	−5,415,748
Continental	12,674,375	193,299	512,693	39,057	.....	13,570,486	12,759,486	118,139
Delta	27,710,389	497,039	1,735,178	33,235	.....	30,193,526	29,210,352	484,363
Eastern	66,040,737	1,295,176	2,936,433	102,759	.....	70,823,480	70,438,468	161,456
National	17,626,389	319,176	1,050,356	168,846	.....	19,241,347	19,909,638	996,792
Northeast	8,669,873	146,985	373,987	3,814	.....	9,294,641	10,486,597	−1,593,506
Northwest	19,018,581	612,586	1,770,501	42,869	.....	21,630,836	21,936,836	−542,858
Trans World	53,133,393	1,735,601	3,667,655	401,823	.....	61,279,842	68,700,260	−6,930,280
United	59,925,090	2,382,946	5,627,840	197,819	.....	69,095,041	78,839,863	−8,310,491
Western	15,163,478	344,756	585,381	28,187	.....	16,211,954	14,105,080	1,950,706
INTERNATIONAL								
American	1,760,082	9,376	144,133	.....	.....	1,991,654	1,797,847	193,818
Braniff	1,747,545	44,569	185,080	.....	.....	2,058,187	2,536,958	−522,925
Caribbean Atlantic	867,447	7,808	43,324	2,429	.....	939,818	787,119	105,408
Delta	808,238	13,738	65,308	.....	.....	893,704	1,146,114	−270,551
Eastern	6,049,037	137,403	249,630	11,570	.....	6,467,303	6,246,633	145,819
Mackey	572,612	.....	16,441	.....	.....	592,331	541,766	32,328
National	374,544	3,556	20,341	29,391	.....	434,918	532,232	−117,314
Northwest	4,963,033	1,075,268	1,170,420	−462	.....	8,093,079	9,016,189	−1,092,933
Pan American Combined	67,147,111	4,799,239	10,164,940	1,290,592	.....	85,657,812	88,347,115	−4,387,477
Alaska	700,697	44,297	91,240	2,155	.....	850,926	1,435,233	−582,918
Atlantic	26,185,019	1,993,133	4,091,728	606,535	.....	33,807,486	34,355,444	−283,722
Latin America	20,686,467	611,362	3,791,695	483,085	.....	26,145,476	28,346,160	−2,228,676
Pacific	19,574,928	2,150,487	2,190,277	198,817	.....	24,853,924	24,217,114	694,464
Panagra	3,625,504	146,607	709,838	12,386	.....	4,771,978	4,926,624	216,690
Resort	.....	.....	.....	1,184,165	.....	1,188,126	1,180,768	7,944
Trans Caribbean [1]	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	10,506,712	1,584,430	1,431,098	379,381	.....	14,739,815	17,000,134	−2,302,304
United	2,815,422	127,656	75,076	27,269	.....	3,097,136	2,779,027	253,198
Western	1,264,744	8,634	33,283	.....	.....	1,317,011	1,104,960	198,529
LOCAL SERVICE								
Allegheny	1,441,882	31,878	103,451	1,546	842,213	2,431,392	3,099,225	−751,609
Bonanza	1,115,567	10,766	35,340	14,867	573,454	1,761,723	1,812,382	−109,603
Central	510,965	19,599	27,523	4,154	688,572	1,257,919	1,432,596	−176,225
Frontier	1,347,474	41,341	108,911	25,636	1,490,533	3,038,471	3,386,844	−398,538
Lake Central	399,201	14,496	24,826	1,206	444,489	1,088,303	1,179,907	−102,185
Mohawk [3]	1,615,384	26,743	64,770	25,372	454,105	2,203,963	2,771,943	−668,762
North Central	2,680,129	86,736	144,928	58,499	1,368,791	4,349,624	5,066,497	−768,532
Ozark	1,523,419	38,963	93,999	2,257	828,918	2,503,223	3,071,287	−609,229
Pacific	1,398,229	33,056	30,681	145,926	586,015	2,198,825	2,899,554	−737,692
Piedmont	1,345,866	23,391	50,829	56,279	949,273	2,464,529	2,929,232	−549,380
Southern	853,552	31,480	49,648	3,594	656,558	1,601,276	1,865,157	−268,038
Trans-Texas	1,074,607	37,443	75,956	19,225	728,262	1,948,472	2,076,070	−130,223
West Coast	1,374,676	28,743	37,209	7,285	926,993	2,383,197	2,827,493	−512,703
HAWAIIAN								
Aloha	964,281	5,404	21,732	38,391	.....	1,056,820	1,100,128	−76,679
Hawaiian	1,409,050	8,699	201,751	488,617	.....	2,140,285	2,264,540	−186,331
CARGO LINES								
AAXICO	.....	.....	2,542,869	43,400	.....	2,548,919	2,200,819	383,100
Aerovias Sud Americana	.....	.....	284,838	456,896	.....	765,962	731,246	25,020
Flying Tiger	.....	64,312	3,263,554	2,460,420	.....	5,820,340	6,835,835	−1,332,361
Riddle	.....	23,016	1,213,692	87,291	.....	1,331,843	1,671,492	−388,492
Seaboard & Western [1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	3,598,017	.....	3,692,269	3,397,008	224,046
HELICOPTER LINES								
Chicago Helicopter	379,392	8,038	2,436	.....	326,121	716,392	748,541	−38,051
Los Angeles Airways	48,898	36,120	43,608	175	229,145	358,560	344,035	14,071
New York Airways	212,688	12,619	23,232	1,350	543,482	795,167	807,540	−13,469
ALASKA LINES								
Alaska Airlines	470,972	154,838	132,196	602,324	552,794	1,923,407	1,964,924	−74,050
Alaska Coastal	171,002	28,925	25,230	4,767	203,701	438,278	510,892	−83,419
Cordova	27,804	22,120	20,279	60,886	150,322	282,860	306,871	−31,558
Ellis	128,056	15,333	16,390	340	130,867	296,935	299,121	−4,810
Northern Consolidated	132,335	134,742	81,402	28,457	305,018	685,346	707,260	−61,011
Pacific Northern	1,053,321	183,164	191,700	12,469	688,431	2,148,186	2,592,771	465,359
Reeve Aleutian	306,372	111,590	99,695	76,114	.....	598,496	541,494	36,395
Wien Alaska	145,019	141,544	74,380	58,800	741,259	1,176,306	1,054,364	114,585

[1] Not available. [2] Property indicates sum of freight, express & excess baggage revenues. [3] Mohawk operations suspended Mar. 18 to Apr. 2 because of strike.

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

ROHR-BUILT JET PODS ON THE WING

The Convair 880 . . .
newest and fastest of America's commercial jet airliners.

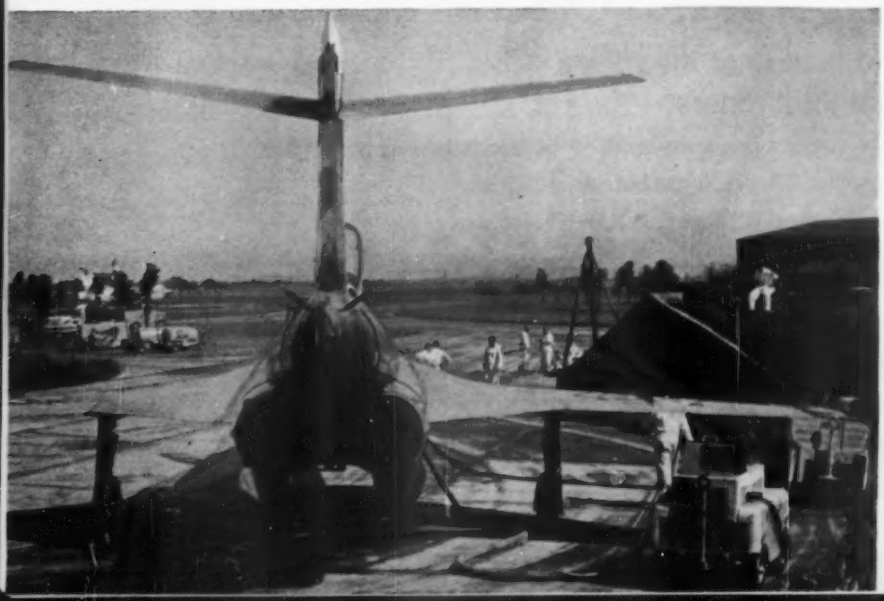
Rohr builds the complex, ready-to-install jet pod units **(shown above)** for this great new airliner. They represent but one of the many major aircraft assemblies that have built Rohr's reputation as the *world's largest producer of components for flight.*

ROHR
AIRCRAFT CORPORATION

Chula Vista and Riverside, California

PHOTO of hydroelectric installation at Bort-les-Orgues, France, was made by Capt. Ronald Yeager in an RF-101C.

Ground, Air Planning Accelerate RF-101C



McDONNELL RF-101C stands in revetment during Royal Flush Five reconnaissance exercise.

By David A. Anderton

Bremgarten, Germany – McDonnell RF-101C Voodoo reconnaissance fighters of the USAF's 66th Tactical Reconnaissance Wing are scrambling in 12 min. on training missions well this side of the Iron Curtain.

That response speed is one indication of the well-planned, well-rehearsed operations of the Wing, starting with the driver of the ground power supply, running through the long chain of ground crews, camera technicians and photo-interpreters and ending with the pilots who wait out the alerts.

Crack teams from the 66th Wing competed in NATO's big annual aerial reconnaissance exercise, Royal Flush Five, held this year at French AFB Aerienne 136 near this German village

PILOT of RF-101C from 66th Tactical Reconnaissance Wing starts from revetment (left), makes sharp climbing turn after takeoff.

RETURNING from photo mission, Voodoo pops brake chute for landing deceleration, comes to a stop. Note tire smoke on impact.

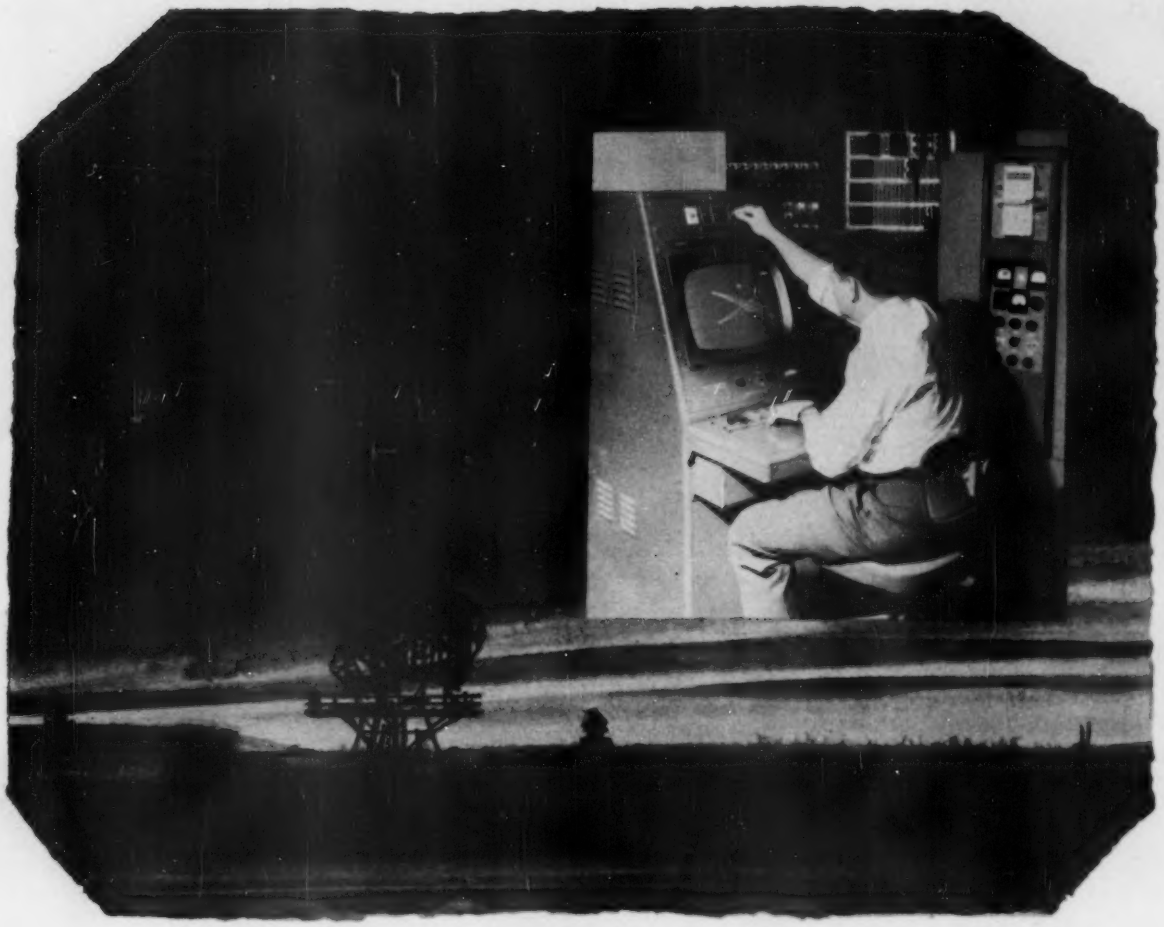
Scramble Rate

at the edge of the Black Forest. In spite of their operational proficiency, the 66th teams lost out in final point scoring to Republic RF-84F units from the Royal Netherlands Air Force, and Canberra PR.7 teams of the Royal Air Force (AW June 6, p. 78).

They were matched against the Dutch on medium-range missions, flown over a target array on a total track distance of about 350 naut. mi. Point spread in that event was about 6%. They tackled the RAF on long-range missions of about 900 naut. mi. total track distance, and came within less than ½% of the Canberra units' score. The RAF team racked up 4,512 points against the RF-101C's 4,491.

The 66th Tactical Reconnaissance Wing is made up of two combined squadrons: the 17th and 18th TAC

TECHNICIANS swarm around camera compartments the instant the Voodoo's engine is cut.



COUNTER-COUNTERMEASURES

. . . accentuate the positive . . . eliminate the negative

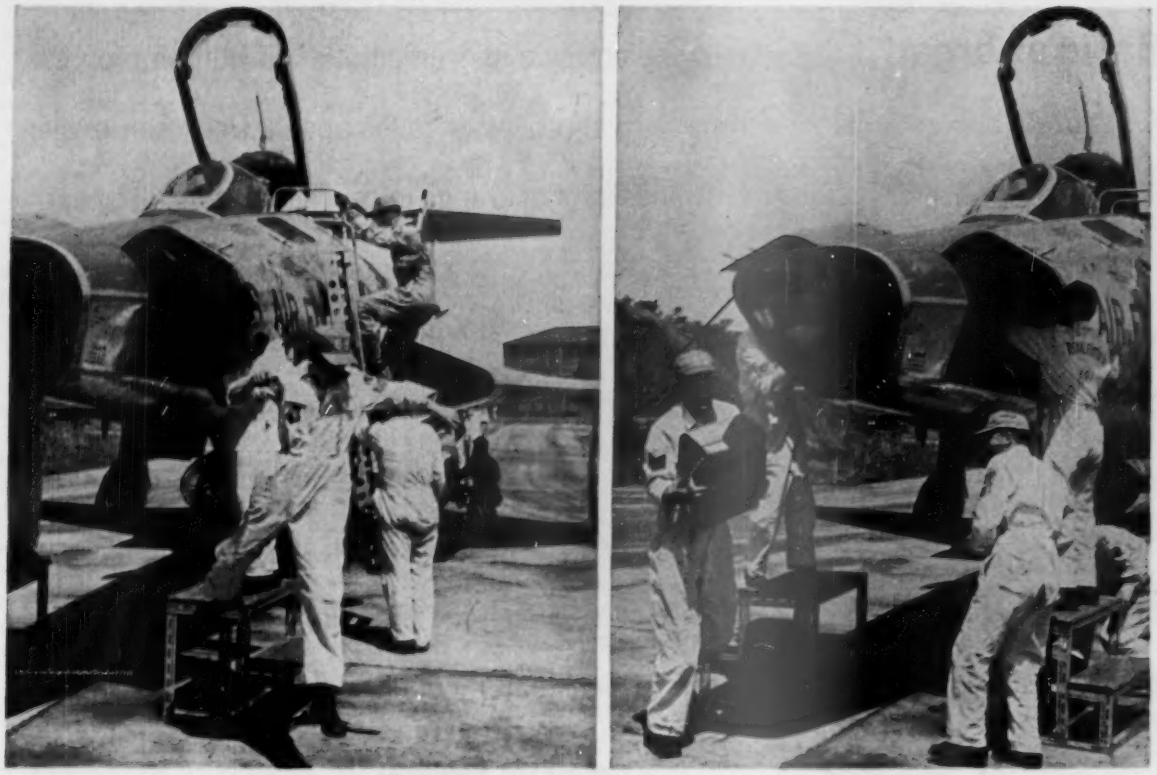
Effective air defense requires high resolution for raid analysis and accurate tracking data for weapon control. Enemy jamming is intended to degrade resolution and accuracy, and saturate the data processing system.

Bendix, as a prime supplier of the "radar eyes" of air defense, is developing new radar and data processing techniques to permit weapon assignment and control in the face of such enemy jamming. A special simulation facility has been developed at the Bendix Systems Division to evaluate new techniques and concepts in real time. Both automatic and semi-automatic methods are being tested. The purpose of the facility is to establish the optimum balance of man and machine functions.

This Air Force program involves system analysis, equipment evaluation, computer design, human factors, and operations research. The results of the investigations are being used as a basis for planning future Air Force programs. It is typical of advanced systems programs being carried out by the Bendix Systems Division. Better engineers and scientists interested in pioneering systems of the future are invited to join this growing team.

Bendix Systems Division
ANN ARBOR, MICHIGAN

THE Bendix CORPORATION



CAMERA BAY is opened at left and technician clears the area for others as the pilot leaves the cockpit to make his "hot" report and more detailed "immediate" report. At right, M/Sgt. Hodder cradles a film magazine and heads for camera section on the run.

Recon Squadrons based at Laon Air Base about 30 mi. northwest of Reims, France, and the 32nd and 38th TAC Recon Squadrons based at Phalsbourg Air Base about 30 mi. south-southeast of Sarrebruck. Wing headquarters is at Laon.

Combined thrust of the RF-101C's pair of Pratt & Whitney J57-P-13 turbojets with afterburners begins to approach the weight of the airplane, so that takeoff performance is spectacular. Basically, the RF-101C is the same airplane as earlier photo-reconnaissance versions, or the long-range fighter models, except that the C versions have been strengthened for low-level sweeps at very high speed.

Camera Array

The plane mounts an array of four cameras in the elongated, truncated nose and two cameras in a huge fuselage belly bay. It is a one-man airplane, and the pilot ". . . is one busy boy," according to a wing officer. "We figure a pilot should spend about two hours per day studying to fly this airplane and take pictures at maximum operational efficiency," he added.

Combat crews of the 66th Wing get proficiency flight checks twice a year under the critical eyes of four tactical evaluation officers from Wing Headquarters. The evaluation pilots fly as wing-men and check the combat crews through every phase of the assigned mission from flight planning to landing.

Evaluation officers also were responsible for checking out the teams that competed in Royal Flush Five: Capt. Hodges, 1st Lts. Williams and Wood in the medium-range category, and Capts. Yeager, Halstead and Fosdick in the long-range missions.

Royal Flush Missions

The six Wing pilots who competed in Royal Flush Five were chosen in a difficult runoff among combat crews, their photo and camera technicians,

ALL CAMERAS UNLOADED, the empty nose section of the McDonnell RF-101C is ready for recharging for the next mission.

Basic as bread... is the role of electronic instrumentation in human progress. And often, as close to home ● Here, a food processor relies upon a Beckman oxygen analyzer to guarantee the freshness and flavor of orange juice. There, using ultracentrifuge, electrophoresis apparatus and chromatograph, immunochemists isolate ragweed allergens in the fight to control hay fever. Farther afield, a Beckman high temperature ceramic potentiometer helps launch and guide a missile ● Everywhere, in the pursuit of quality, the quest for a cure, the maintenance of leadership—Beckman is part of the plan. And wherever they are—in the laboratory, in the factory or in space—Beckman components, instruments and systems are basic ● They are the things on which Beckman builds its success...upon which users of Beckman products build theirs.

Beckman®

INSTRUMENTAL IN YOUR FUTURE 25 YEARS 1935-1960

BECKMAN INSTRUMENTS, INC. ELECTRONIC COMPONENTS, INSTRUMENTS, SYSTEMS...FOR ANALYSIS, MEASUREMENT, COUNTING AND CONTROL

EXECUTIVE OFFICES: FULLERTON, CALIFORNIA | DIVISIONS: BERKELEY • HELIPOT • INTERNATIONAL • SCIENTIFIC & PROCESS INSTRUMENTS • SPECIAL PROJECTS • SPINCO • SYSTEMS | SUBSIDIARIES: BECKMAN INSTRUMENTS, G.m.b.H., GERMANY • BECKMAN INSTRUMENTS, LTD., SCOTLAND

© 1960 B. I. I. BC 60144

ground crews and maintenance personnel which were the best the Wing had.

"During the runoff," said one evaluation pilot, "we sent them out over an airfield that had 96 airplanes on it. They had to make one pass, photograph the field, and give us the usual hot report from visual reconnaissance on landing. One pilot estimated the field had 93 aircraft, and another said 97.

"Another one of their targets was a railroad yard with 253 cars; one pilot reported 235 cars and the other said there were 250. That'll give you an idea of how good these pilots are."

Most of the professionals in the photo-reconnaissance business who attended the NATO exercise as observers or competitors agreed that one photo brought back by Capt. Ronald Yeager of the 66th Wing topped the meet for picture perfection. The shot was taken parallel to the face of a big dam at Bort-les-Orgues, 35 mi. southwest of Clermont-Ferrand, France. Yeager was flying at 290 kt. and 500 ft., and took the picture with the left-oblique nose camera.

The original print shows ripples in the water and tiny landscape details with high clarity and contrast.

Yeager, like most of the Wing pilots, has somewhat over 300 hr. on the RF-101C, and knows the airplane and its systems. His sweep across the dam face was made a little slower than the usual flight speeds of the RF-101C: 360, 420 or 480 kt., depending on environmental conditions. There was considerable low-level turbulence that day, and weather was threatening, building up into late-afternoon thunderstorms.

Yeager passed the dam at 1432 hr. and got his shot in routine fashion.

Morning Briefings

General briefing for the day's missions was held in the morning at eight o'clock; pilots were briefed on weather for the day, the alternate fields and any special conditions of general value. Nothing was said about targets at this briefing. It also provided an opportunity for competing forces to reach mutual understanding on a number of terms which apparently were being interpreted two ways.

One morning the discussion included: an argument on what was meant by the words, "in the vicinity of"; a definition of the center of the airfield—a check point to determine the accuracy of that specific kind of target run-in; and which direction is counterclockwise.

After the briefing, pilots assigned to the day's mission headed for trailers near their airplanes and waited until H-hour—nine o'clock scheduled during the meet, but delayed once until 11

* What's Behind This?

a major advance in the state of infrared art

by HRB-SINGER, INC.

At long last HRB is permitted to admit openly their relationship to the revolutionary "Manhattan Strip," taken with IR equipment developed at HRB-SINGER. The map-like image was photographed under conditions of complete darkness. Amazingly clear, accurate and continuous data of the Manhattan terrain resulted.

IR surveillance equipment which meets military requirements, is continually being developed and improved at HRB-SINGER. Although RECONOFAX, the trade name applied to HRB IR equipment has been employed primarily in aircraft, it could be used in other vehicles such as satellites for scanning areas several hundred miles wide.

If you are interested in HRB's outstanding advances in the development of new concepts and systems for reconnaissance, surveillance, and infrared detection—military and industrial personnel with a need to know, contact HRB-SINGER, Dept. I.

ELECTRONIC RESEARCH AND DEVELOPMENT in the areas of:

Communications • Countermeasures • Reconnaissance • Human Factors • Intelligence • Weapons Systems Studies and Analysis • Nuclear Physics • Operations Research • Antenna Systems • Astrophysics

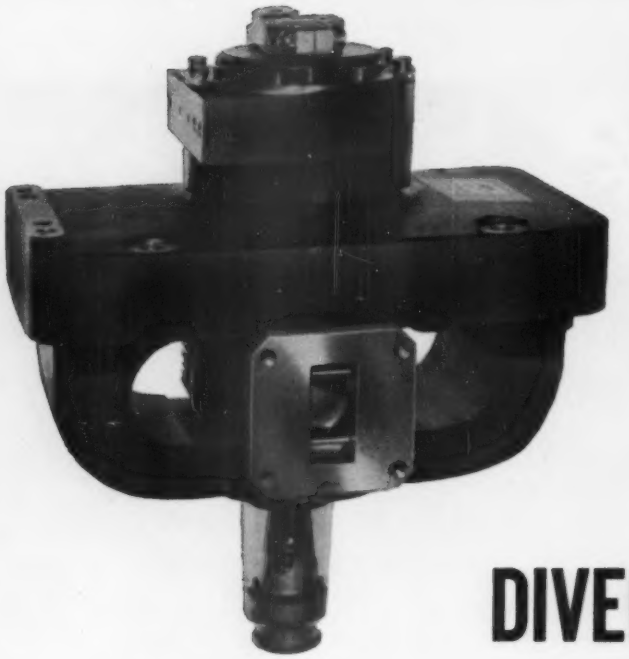
H B

HRB-SINGER, INC.

A SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY

Science Park, State College, Pa.

SINGER



NEW MAGNETRON FOR RELIABLE FREQUENCY DIVERSITY RADAR

Frequency diversity and higher definition airborne radars are achievable with a new Litton Industries X-band hydraulically tunable Magnetron.

This tube is another in the growing family of hydraulically tuned pulse Magnetrons we introduced two years ago for new equipment and retrofit frequency diversity requirements.

Designated the type L-3305, this Magnetron can be tuned at rates up to 100,000 megacycles per second over the frequency range of 8600 to 9500 megacycles. Pulse stability at peak power output in excess of 65 kilowatts is maintained while the tube is tuned at these extremely rapid rates.

The design and capability of this tube reflect our experience as a major supplier of thousands of hydraulically tuned CW Magnetrons for countermeasures. The ruggedized design permits application of the L-3305 Magnetron where severe shock and vibration conditions may exist. The hydraulic actuator is an integral part of the tube design, resulting in smooth, positive tuning action. Provision is made for the adjustment of the hydraulically controlled valve directly to the actuator, insuring nearly zero error, maximum reliability and ease of maintainability. Flexibility of system design is possible since the compact power supply and reservoir system may be remotely located.

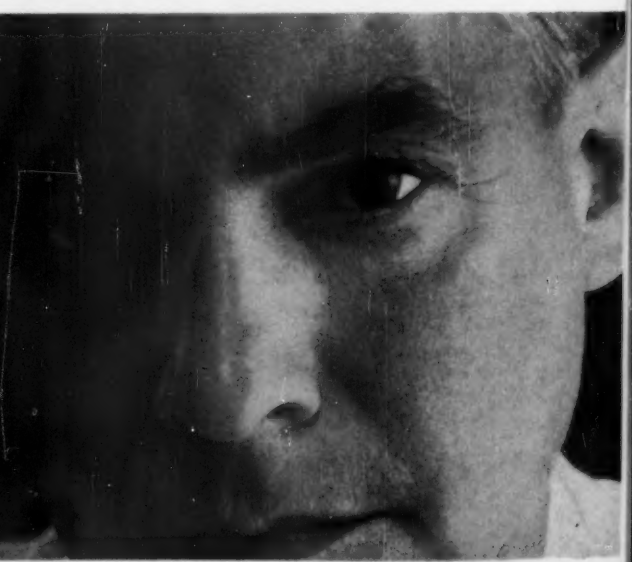
Reliability, long life both in-service and on the shelf and immediate full power operability at any time are built-in features of this exactingly constructed tube.

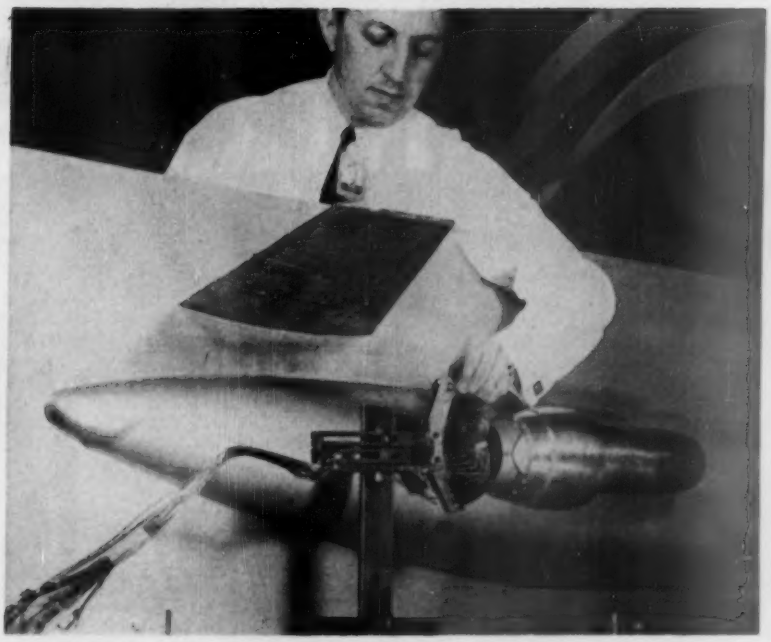
We will gladly send you additional information, if you will write to Litton Industries, Electron Tube Division, Office A-14, 960 Industrial Road, San Carlos, California.

LITTON INDUSTRIES Electron Tube Division

BARRATRON® TRANSMITTING TUBES • MAGNETRONS • KLYSTRONS • TRAVELING WAVE TUBES • BACKWARD WAVE OSCILLATORS • GAS DISCHARGE TUBES • NOISE SOURCES CROSSED-FIELD AMPLIFIERS • HIGH DEFINITION CRT • DIRECT-WRITING CRT COLOR CRT • STORAGE TUBES • MICROWAVE FILTERS • DUPLEXERS • TR TUBES

CAPABILITY THAT CAN CHANGE YOUR PLANNING





GE Studies Caravelle Thrust Reverser Design

Wind tunnel tests of scale model of General Electric-powered Caravelle VII are being conducted to determine operating characteristics of GE's thrust reverser. Reverser, designed to deliver 6,000 lb. reverse thrust, stows externally, becoming part of the after body of short-cowl nacelle. Air at 1,000F is blown through simulated engine and aft-fan units, enabling engineers to measure effects of the hot reverse thrust gases on fuselage, empennage, flaps, runway and tires.

a.m. by weather—to get their final mission briefing. This came in the form of a standardized briefing, in writing handed to them in a sealed envelope by one of the judges. The timing started when the pilot got the envelope and continued during his planning of the mission.

He had a maximum of 40 min. to study the briefing, plan his flight, get into the airplane and start to roll.

Here's how one mission looked from the 66th Wing's revetments, sprawled out in one of the three dispersal areas of this French fighter-bomber base.

Mission Activity

The lieutenant burst out of the trailer, jumped the flight of steps and almost fell into a waiting Air Force crew car. As it started to pull out of the trailer area, white-coveralled mechanics began a wild signaling to the crews standing near the distant revetment.

Technicians in the revetment hooked up the air line from the ground power unit to the RF-101C and stood by the power supply.

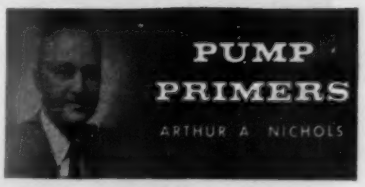
The blue car pulled into the revetment, the pilot tumbled out, and climbed the ladder held against the cockpit by the crew chief. Up the ladder after him scrambled the sergeant, and started the strap-in routine and pilot check while the pilot completed the last few items on his takeoff check list and started the engine.

On signal the pilot started his roll and the timer standing in the revetment stopped his watch. It would start again when the plane began its roll down the runway.

Traffic control during the exercise was somewhat of a problem, not only because of the numbers of airplanes participating, but also because the French air force was operating an F-84F fighter-bomber outfit out of the base right through the exercise. Language problems were expected to give some troubles, also, and so it was decided for these and other reasons that timing would cease during portions of the mission between engine start and takeoff, and between the pass over the tower at the end of the mission and the time the engine was cut in the revetment.

Takeoff Timing

A judge in a jeep trailed the RF-101C out to the end of the runway and parked well clear of the blast from the engines. The Voodoo rolled into position angled to the runway while the pilot ran up the engines briefly, left and right alternately. Then he slowly taxied out to line up for takeoff, held the brakes while the engines blasted to full power, kicked in the afterburners with crashing booms that echoed across the flight line, and started



Unique combination of advantages in GEROTOR aircraft pumps

The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump – simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance at high altitudes and has low wear over a long service life. In addition, it is balanced and extremely quiet in operation.

Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See Figure 1).

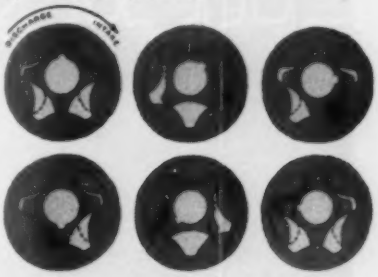


FIG. 1

Low relative speed and closely held clearances between the two Gerotor elements mean high mechanical efficiency is maintained.

Slow opening of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.

Valveless design insures absence of mechanical troubles associated with the operating complexity and service and wear problems inherent in valve construction.

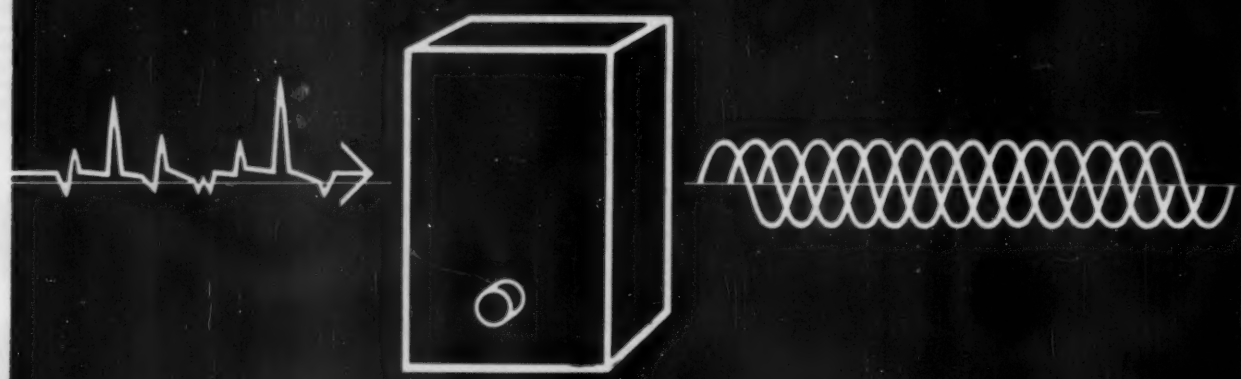
Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

Technical data—is available and your inquiry is invited. Write:

W. H. NICHOLS CO.

48 Woerd Avenue, Waltham 54, Massachusetts

POWER INVERSION



FOR ANY ENVIRONMENT

New Hamilton Standard developments mark significant advances in static inverter performance, reliability

- **Operating ambients from −55 to +125°C**
- **Frequency regulation to ± ¼ cps**
- **Voltage regulation to ± 0.87%**
- **Efficiencies greater than 80%**
- **Transient and overload protection**

These characteristics represent major improvements in inverter performance—improved performance *without* sacrifice of reliability. In fact, Hamilton Standard has achieved significant reliability increases in all inverters now under development. This development program includes over 40 models with extremely favorable power-to-weight ratios and outputs ranging from 15 va to 10 kva, single or polyphase, 60 or 400 cps, square or sine wave.

OTHER POWER CONVERSION EQUIPMENT, produced by Hamilton Standard, includes static converters (AC-AC, DC-DC), static power supplies (AC-DC), transient suppressors, and thermoelectric converters.

NEW POWER CONVERSION PROJECTS now in advanced stages of study at Hamilton Standard are:

- Constant frequency input/variable frequency output
- Variable frequency input/constant frequency output
- Random variable input/controlled variable output
- Static circuit protection
- Controls for fuel cells

ADVANCED POWER SOURCE DEVELOPMENT is just one of the areas of electronics in which Hamilton Standard is working today. The company's experience also includes instrumentation, monitoring, and electronic flight control systems for missiles and aircraft. These activities, plus the technologies developed in producing electronic controls for environmental conditioning systems, starters, turbojet and rocket fuel controls, propellers and ground support equipment, establish Hamilton Standard as a dependable source of widely diversified electronics capabilities.

WHATEVER YOUR REQUIREMENTS in power inversion are, Hamilton Standard can serve you well. For full details write Hamilton Standard Electronics Department, 70 Main Street, Broad Brook, Connecticut.

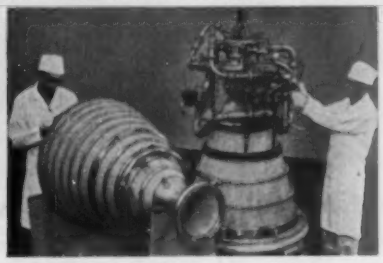
HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

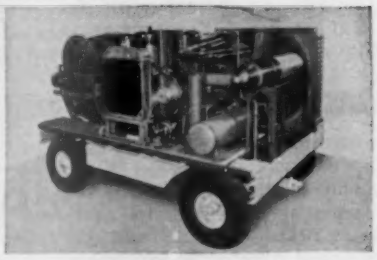
WINDSOR LOCKS, CONNECTICUT

SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD

ENVIRONMENTAL CONDITIONING SYSTEMS for space vehicles and such advanced aircraft as the B-58, 880, B-70 are important aspects of Hamilton Standard diversification.



ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.



GROUND SUPPORT EQUIPMENT. Hamilton Standard is presently producing a wide range of GSE for both missiles and aircraft—from special tools to complete systems.

Helicopter Turret Uses Remote Control

Lightweight turret system for helicopters permits remote control for external armament or battlefield surveillance television camera. Unit shown here employs an M-60 7.62 mm. machine gun. System was developed by General Electric's Missile Production Section, under contract from U. S. Army Ordnance. Cockpit control is handled like a pistol.

his takeoff roll. Timing began again at that instant.

Power of the Voodoo was most apparent to observers at the exercise, who were astonished to see such a large airplane airborne and climbing steeply by the time it had reached the midpoint of the runway. Normal operational takeoffs of the Republic RF-84Fs flown during the exercise took most of the runway, and their pilots kept the planes on the deck and straight out of the field before starting the climbing turns to minimum altitude for their low-level sweeps.

But the Voodoos were climbing for altitude in tight turns right off the runway, and on one occasion innocently came within feet of a midair collision as a result. A Voodoo was turning left out of the field and climbing sharply, when a Thunderflash from Second ATAF roared over the field low and fast in his checking pass at the end of a mission. He was supposed to report one minute out and from 1,500 ft., said some observers, but did not report and came in at about 300 ft., roaring above the taxiway to the left of the live runway.

Near-Miss

The near-miss occurred just above the dispersal area for Second ATAF teams, and emphasized the need for careful reporting in on future missions.

Minutes ticked by, and finally the Voodoo's pilot reported in and flashed across the field in a blistering highspeed run followed by an upward victory roll. Turning tightly out of the roll, he swung into the pattern, opened the speed brakes and dropped the gear and flaps for landing. Once around the circuit, and then a long low approach from way out brought the Voodoo into a screeching landing with tires striking smoke on impact. The pilot popped the brake chute and the Voodoo dragged to a stop down the runway.

Back toward the revetment the plane taxied, its brake chute wobbling uncontrollably in the blast from the tail-pipes. Near the revetment the pilot released the chute, and turned toward his final roll into the area.

Ground crews stood by, waiting for his signal to dash into position and remove the camera magazines. At the head of the ground markings stood a traffic director, signaling the Voodoo pilot into position. Left of the airplane stood the crew chief holding the boarding ladder, and in semi-circles, left and right, waited groups of mechanics.

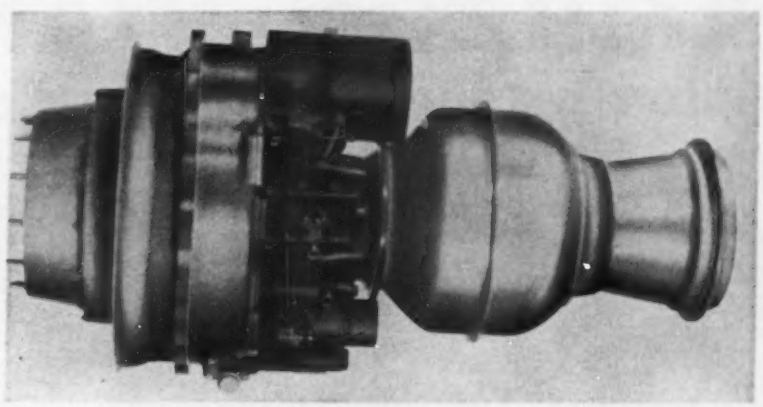
Canopy open, the Voodoo taxied in, and the lieutenant lifted his left hand with two fingers extended, giving the ground crew the numbers and positions of the cameras which had been used. Slowly the plane rolled to position and stood a moment. Then the timer gave the start-time signal, and simultaneously the traffic controller signaled for engine cutoff and the technicians made a dash for the airplane.

Film Removed

They opened quick-release fasteners, lifted the side hatches of the camera compartments and went to work on the magazines. In a matter of a few seconds one crewman after another made a dash across the concrete revetment floor, carrying a heavy film magazine to the trailer for developing and processing.

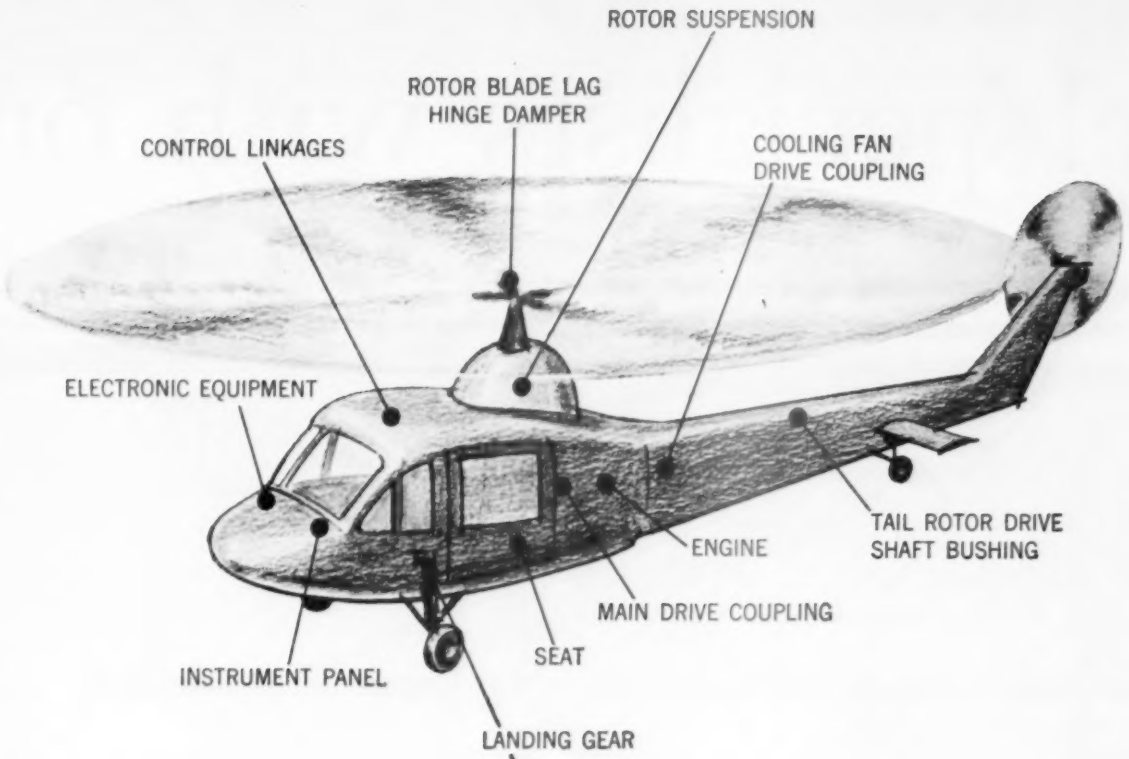
The pilot scrambled out and down the ladder to start his "hot report" and within a few minutes his visual reconnaissance was being matched to the data furnished by the wet negatives inside the processing trailer. Later—but only a few minutes later—there would be time for a more detailed report, the "immediate report," which would include a thorough analysis of target pictures and a complete report on their characteristics.

In the revetment, a ground power tug marked with a stencil saying, "Air Power Starts with Ground Power," towed a fork up to the front wheels of the Voodoo and, after the joint had been made, hauled the plane out of the



Continental Develops 500-hp. Turboshaft Engine

Continental Aviation & Engineering Corp. is developing a 500-hp. turboshaft engine, designated Model 217-5A, primarily for rotary wing application (mockup is shown above). Engine weighs 210 lb. and has a 6,000-rpm. output shaft. Also under development is the Model 217-6A, a 2,100 rpm. turboprop version; flight test is set for next April.



critical points for *vibration/shock/noise* control

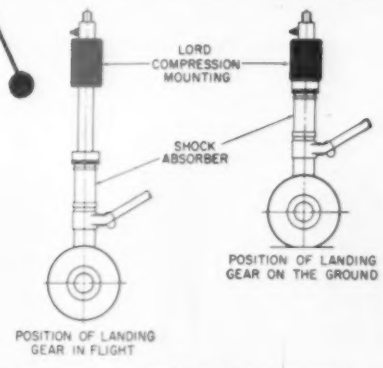
Improved flight characteristics, less noise and increased service life are major design objectives of helicopter engineers. LORD offers maximum assistance through advanced vibration/shock/noise control techniques and superior materials.

At critical points, LORD elastomeric mountings combat the undesirable effects of engine vibration, rotor disturbances, unbalance, taxiing shocks, operational noise, shaft misalignment and blade bottoming.

Close teamwork between helicopter engineers and LORD results in vital "breakthroughs" in cost, size, weight or service life. For example, an elastomeric rotor blade lag hinge damper provides improved performance with substantial savings in cost and weight.

Utilize LORD capabilities in vibration/shock/noise control to implement your helicopter, VTOL, STOL or convertiplane project. LORD experience plus modern facilities for research, custom engineering, production, and testing will assure an optimum solution. Contact your nearest Lord Field Engineering Office or the Home Office, Erie, Pa.

ADVANCED MATERIALS PERMIT UNIQUE DESIGNS



The low temperature flexibility, oil resistance and excellent damping properties of Lord BTR® elastomer are utilized in new landing gear spring. BTR compression mounting absorbs peak energy on landings, then protects landing gear and fuselage during ground operations.

LORD®

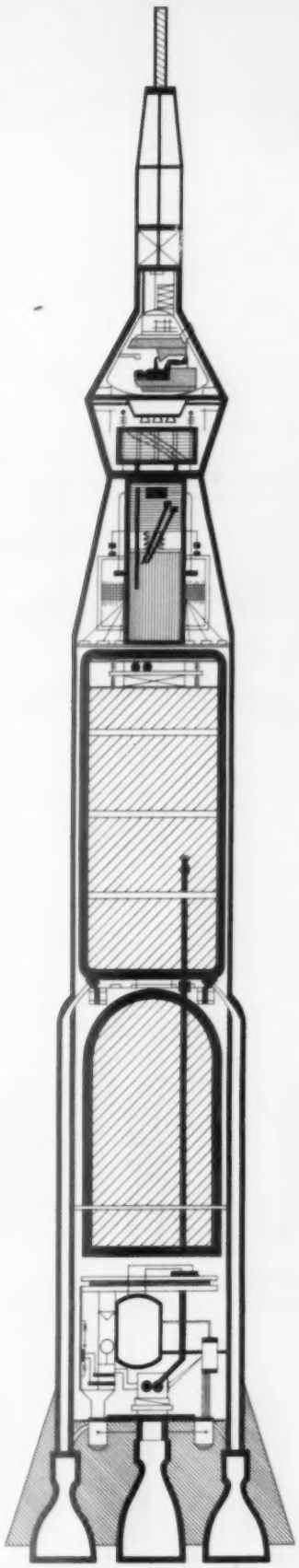
FIELD ENGINEERING OFFICES

ATLANTA, GEORGIA - CEdar 7-9247
BOSTON, MASS. - HAncock 6-9135
CHICAGO, ILL. - MIchigan 2-6010
DALLAS, TEXAS - Riverside 1-3392
DAYTON, OHIO - BAldwin 4-0351
DETROIT, MICH. - Diamond 1-4340
KANSAS CITY, MO. - WEstport 1-0138
LOS ANGELES, CAL. - HOllywood 4-7593
NEW YORK, N. Y. (Paramus, N. J.)
New York City - BRyant 9-8042
Paramus, N. J. - Diamond 3-5333
PHILADELPHIA, PA. - PEnnypacker 5-3559
SAN FRANCISCO, CAL. - EXbrook 7-6280
WINTER PARK, FLA. - MIdway 7-5501

"In Canada—Railway & Power Engineering Corporation Limited"

LORD MANUFACTURING COMPANY • ERIE, PA.

Meet the specialists of space.....

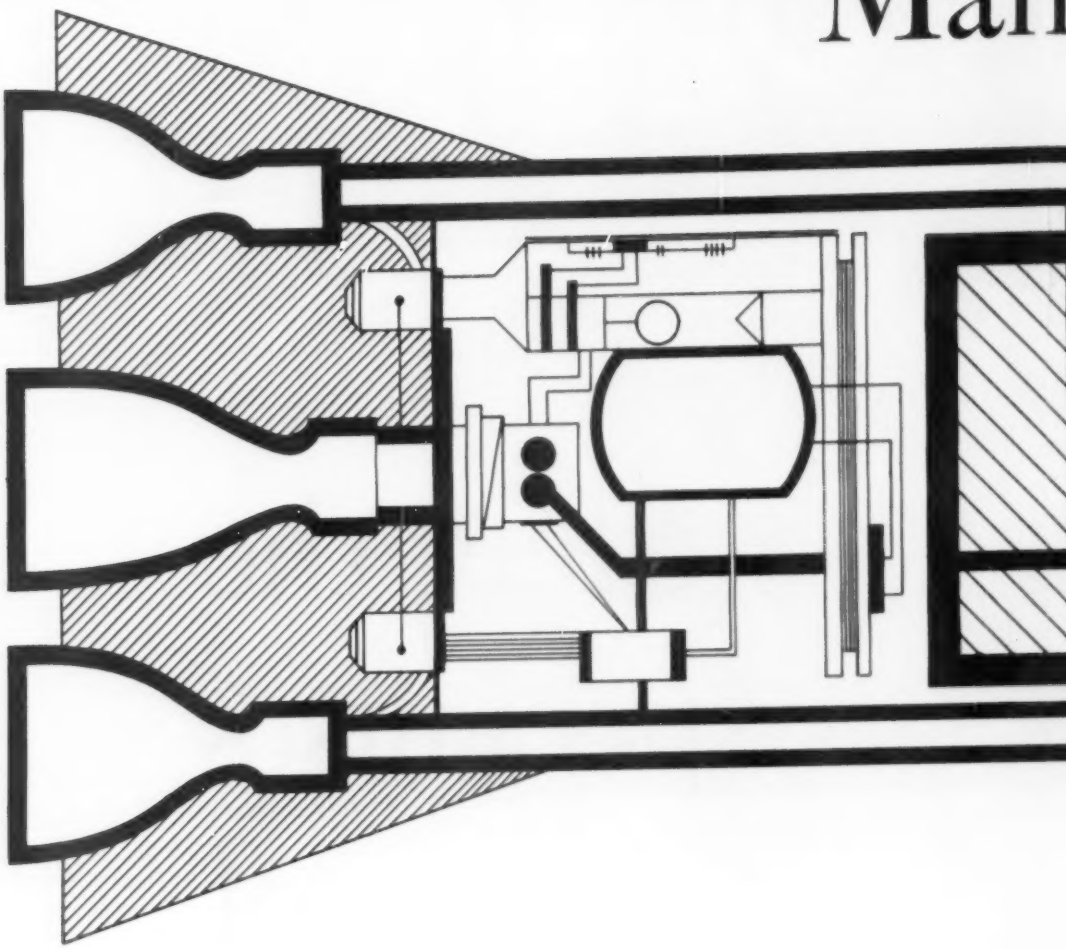


NEVER IN history have the talents of so many scientific and technical specialists been combined in order to achieve a single definable goal: exploration of space. Proof is provided by Honeywell. For at Honeywell alone, analysis shows that scientists and engineers assigned to space projects represent almost every division of the physical and chemical sciences. To demonstrate the range of skills required in the design, launching, propulsion and guidance of space vehicles, Honeywell's Specialists of Space—from astrodynamicist to sociologists and theoretical physicists—are catalogued on the inside pages.

Honeywell

H Military Products Group

Man



ACOUSTICIAN

AERODYNAMICIST

AERONAUTICAL ENGINEER

AGRICULTURAL ENGINEER

ASTRODYNAMICIST

ASTRONO

MAGNETIC DEVICE ENGINEER

MATHEMATICIAN

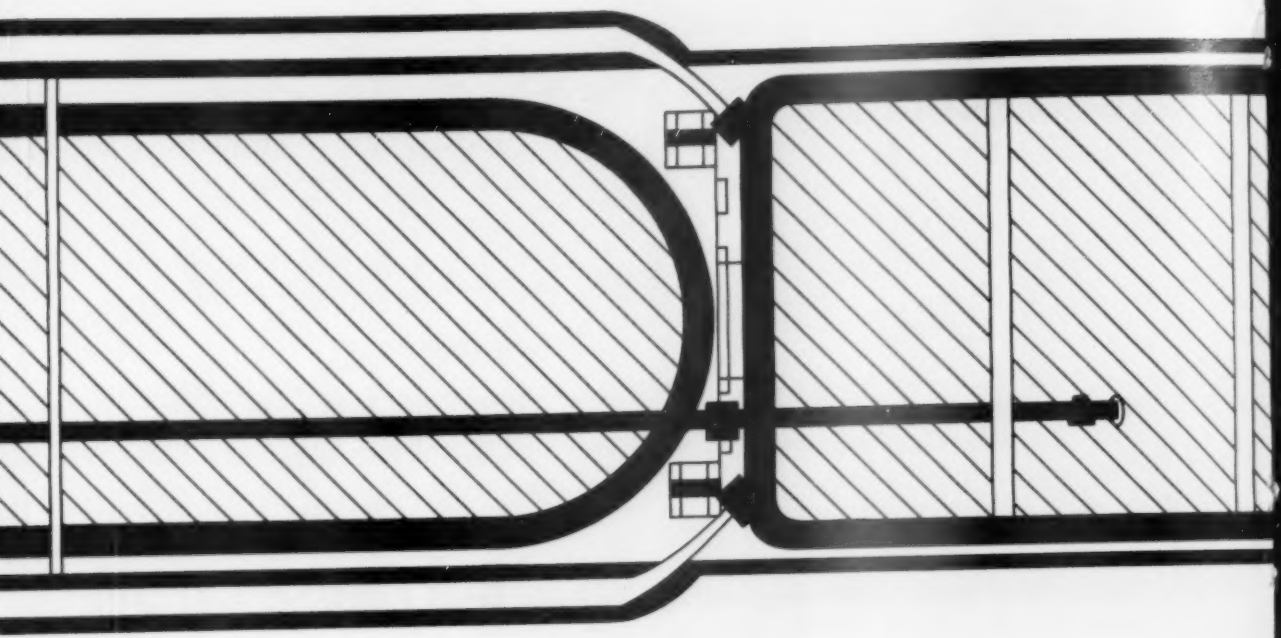
MECHANICAL APPLICATIONS ENGINEER

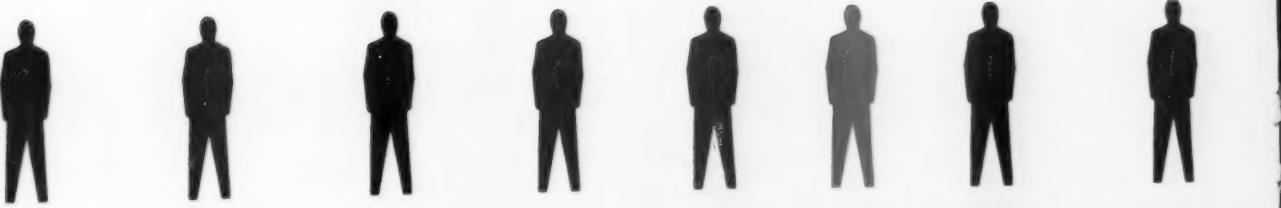
MECHANICAL ENGINEER

MECHANISMS SPECIALIST

ELECTR

ny specialists with one

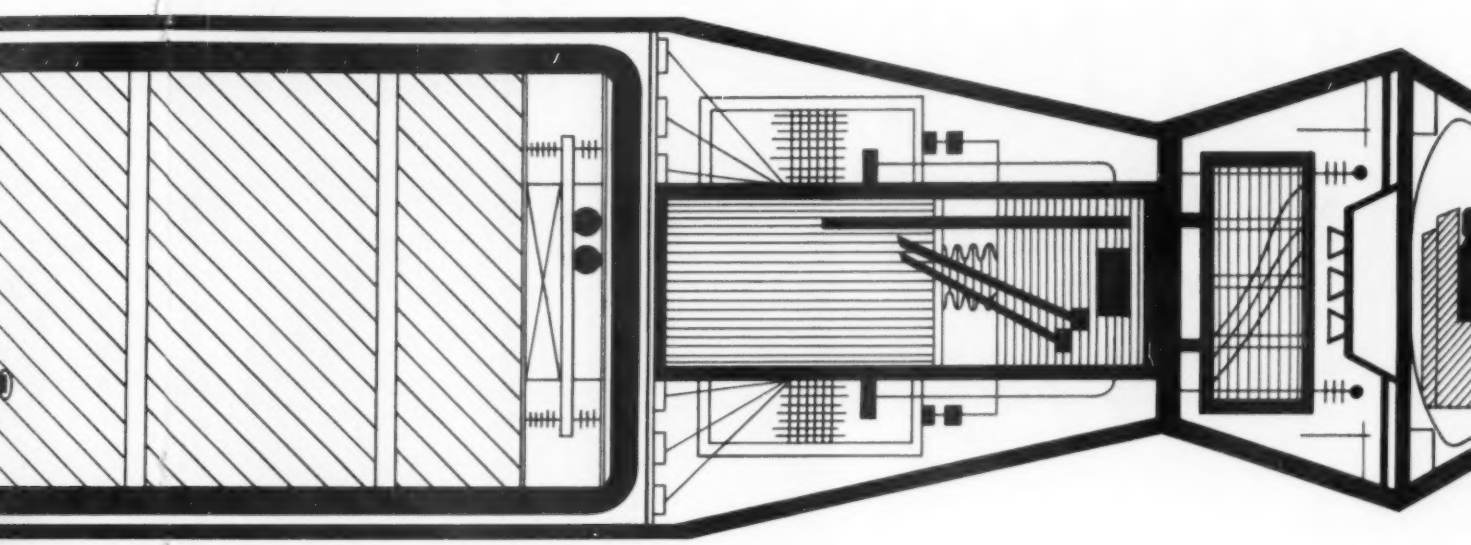


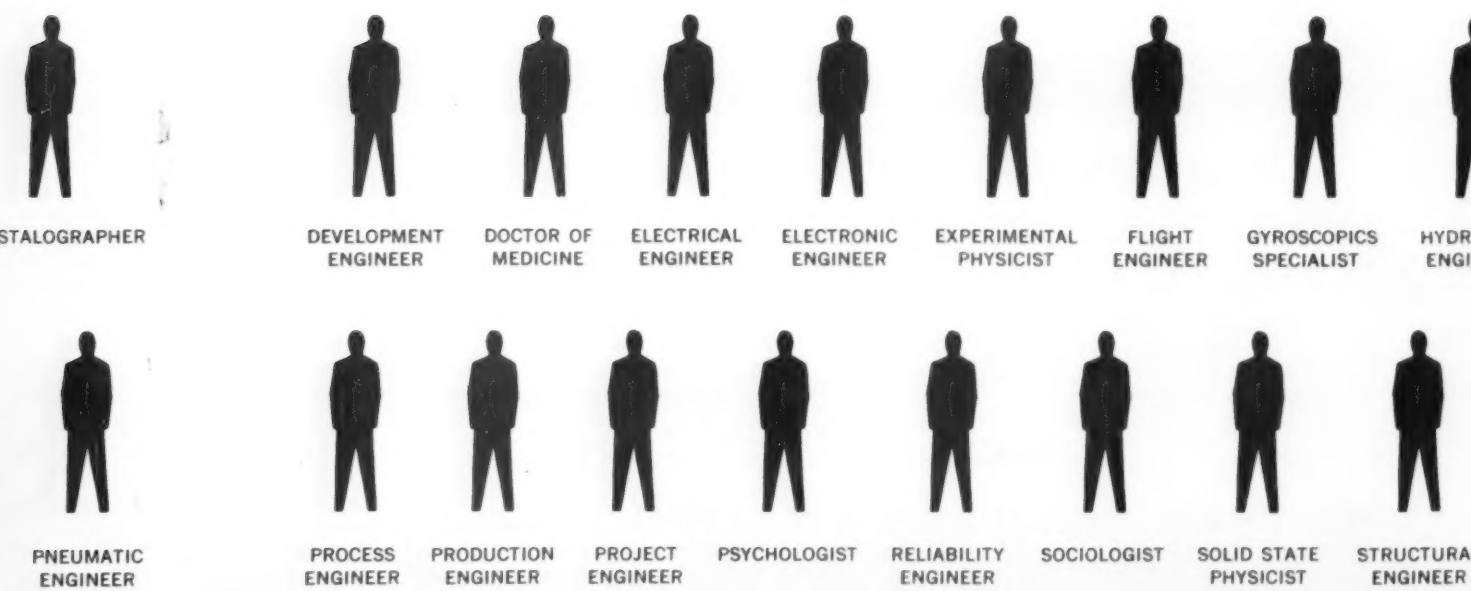


RONOMER | ASTROPHYSICIST | BIO-CHEMIST | BIO-PHYSICIST | CERAMICS SPECIALIST | CHEMIST | COMPUTER SPECIALIST | CRYSTALOGRAPHER

MEDICAL ECTRONIC ENGINEER | METALLURGICAL ENGINEER | METHODS ENGINEER | NUCLEAR PHYSICIST | OCEANOGRAPHER | ORGANIC CHEMIST | PHYSICAL CHEMIST | PNEUMATIC ENGINEER

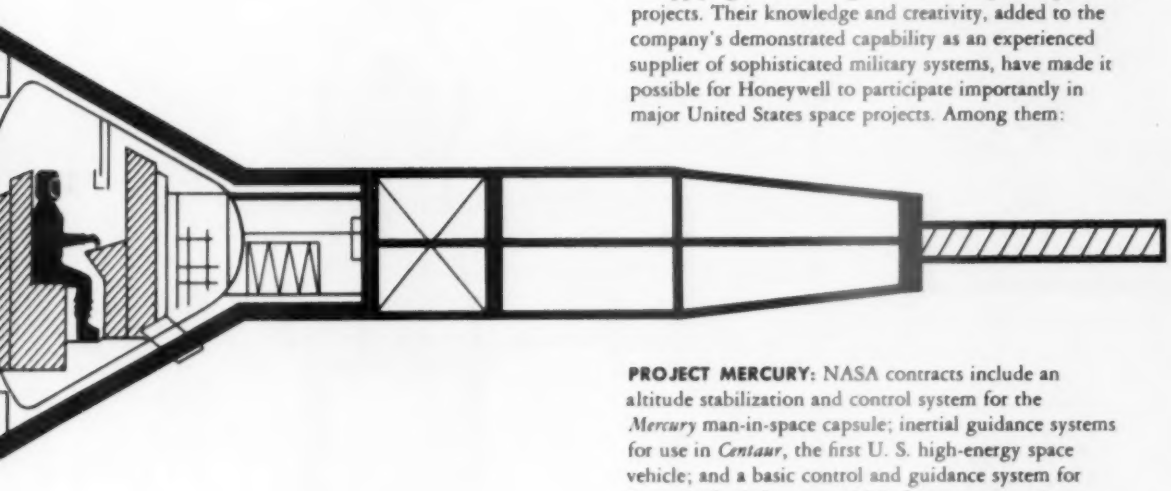
one goal: supremacy in s





space

Illustrated on the diagram are the professional specialties represented by one or more men at Honeywell who are applying their training and skills to space exploration projects. Their knowledge and creativity, added to the company's demonstrated capability as an experienced supplier of sophisticated military systems, have made it possible for Honeywell to participate importantly in major United States space projects. Among them:



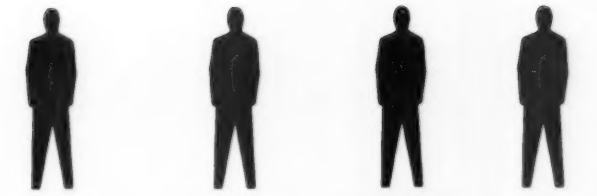
PROJECT MERCURY: NASA contracts include an altitude stabilization and control system for the *Mercury* man-in-space capsule; inertial guidance systems for use in *Centaur*, the first U. S. high-energy space vehicle; and a basic control and guidance system for *Scout*, the basic booster vehicle for space research.

SPACE CABIN SIMULATOR: Honeywell has delivered to the Air Force's School of Aviation Medicine a device for simulating exactly the conditions under which two men would be required to function in space. Such tests extend as long as 30 days.

DYNAMIC ANALYZER: Work is in progress on a device that will test satellites and their components on earth under most of the conditions and phenomena encountered in space. The Dynamic Analyzer will be delivered to the Air Force's Wright Air Development Center.

Honeywell capability is demonstrated also by work closely related to space exploration. Among these projects are ASROC, Thor, Atlas, Titan, Minuteman, Bomarc, Polaris, and a number of others that involve application of advanced technological concepts.

If you would like further information about Honeywell's competence at helping to solve space-age problems, write to Honeywell, Military Products Group, Minneapolis 8, Minnesota. In Canada, write Honeywell Controls Limited, Vanderhoof Ave., Leaside, Toronto 17, Ontario.

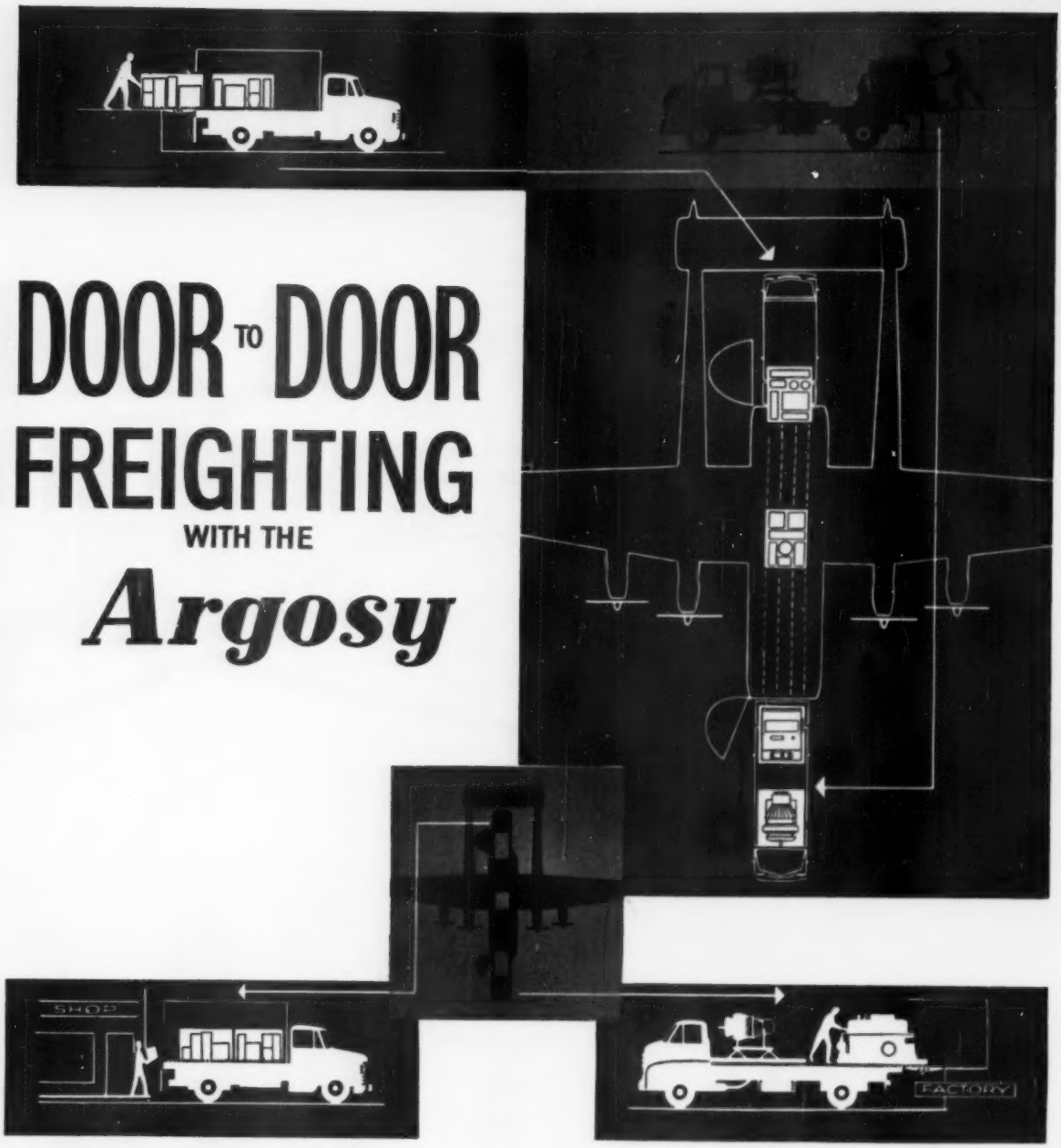


HYDRAULIC ENGINEER | INFORMATION THEORY ANALYST | INORGANIC CHEMIST | LOGICAL DESIGNER

TURAL NEER | SYSTEM ANALYST | THEORETICAL PHYSICIST | THERMO DYNAMICIST | TRANSDUCER ENGINEER

Honeywell

Military Products Group



DOOR TO DOOR FREIGHTING WITH THE *Argosy*

The revolutionary Rolamat-Argosy system of unitized loading

One pallet, one waybill—one streamlined operation door to door. That's the revolutionary air freighting system with the Rolamat-equipped Argosy.

Small parcels are built up on the pallet, the unitized load rolled onto a truck and straight from the truck into the Argosy.

Pallets can be linked together to take heavy bulky freight, such as machinery. No packaging is needed. Loads up to 13¼ tons, less than 6 ft. 8 ins high and 8 ft. 8 ins. wide, can be slid easily into the Argosy's 47 ft. long freighthold.

A complete turnround at the airport takes only 20 minutes, including refuelling.

Off-loading is just as easy. The cargo is rolled onto the lorries backed up at both ends of the fuselage.

No special handling technique is required—lifting trucks and cranes can thus be completely dispensed with.

Rolamat saves time, saves trouble, saves money, saves labour, saves warehouse space. Yes sir, things really *move* with the Rolamat-Argosy system of unitized freight handling!

Designed to bring the cost of air freight down to earth

HAWKER SIDDELEY AVIATION 32 Duke Street, St. James's, London, S.W.1.

revetment and turned it to position for the next sortie.

Normal layout of cameras in the RF-101C includes a group of four mounted forward in the specially modified nose section and two mounted in a large fuselage compartment. The forward four are:

- **Nose camera,** shooting forward and slightly downward from the horizontal. Camera is a Fairchild Camera & Instrument Corp. KA2-12 with a 12 in., *F*/4 lens, and a minimum exposure time of 1/600 sec. Film magazine is built by General Electric.
- **Vertical camera,** mounted to shoot directly downward. Also a Fairchild design, this camera is a KA-2 type with a 6-in., *F*/6.3 lens, with a minimum exposure time of 1/800 sec. Magazine is made by Chicago Aerial Industries.
- **Two oblique cameras,** both type KA-2 with 6-in., *F*/6.3 lenses, and minimum exposure time of 1/800 sec. Magazine is also made by Fairchild.

Photo Coverage

Both the oblique cameras combined with the vertical give horizon to horizon coverage when the plane is flying straight and level.

Cameras mounted in the belly are primarily intended to photograph large target areas from high altitude, rather than concentrating on individual targets in low-level runs. The two belly cameras are Fairchild KA-1 type, with 36-in., *F*/8 lenses, and a minimum exposure time of 1/700 sec. Working together, they cover a 52-deg. included angle cone, and provide the usual 60% overlap between adjacent frames to furnish stereo pairs of prints for photo-interpretation.

All the cameras are equipped with automatic control gear, which can be preset for the type of lens and filters, and which leave the pilot free to worry about all the other things he has to do in the cockpit. But if the system malfunctions or if for some reason the pilot wants to shoot manually, the control systems have this provision also.

Viewfinder Details

The installation includes a viewfinder for the pilot, which gives him a direct visual presentation in the cockpit about where a gunsight is usually mounted. The finder gives four fields of view: vertical, at 30 deg. and at 60 deg. forward, measured from the vertical, with an included angle of view of 30 deg., and a wide-angle view of 85-deg. included angle, extending from 5 deg. aft to 80 deg. forward measured from the vertical.

Tied into the system is an automatic exposure control system which works like the standard type of photo-electric exposure meter except that it is much more sensitive and much more complex. This unit has to be able to change camera settings in flight to accommodate altering light conditions, and therefore uses a double-eye system to measure reflected light in two areas. As the plane flies over a target area, any difference in the light intensity reflected to both "eyes" is detected and amplified to change the camera settings as the light changes.

Final sophistication in a moder photo-reconnaissance system is a method for eliminating target motion. During low-level, high-speed sweeps on overcast or cloudy days, the exposure times determined by the light-meter system are large and consequently the image of the target would be blurred. There are two ways of eliminating this: move the camera, or move the film.

Both big vertical cameras in the Voodoo's fuselage are rigged together and "panned"—moved with the direction of flight of the airplane—to eliminate motion of the target.

But the smaller cameras have an image motion compensating system built into the film magazines, which derives its basic data from the so-called V/H signal—speed/altitude ratio—and use that ratio to adjust the speed of the film through the magazine. As an example, a film being exposed in a vertical camera during a 400-kt. run at 500 ft. altitude would be moved through the magazine at about 16 in. per sec.

Systems Engineering

Systems engineering on the camera controls was done by the Allen B. Du Mont Laboratories, and much of the control gear was built by them. Major contributions to the over-all reconnaissance system of the RF-101C were made by Chicago Aerial Industries, which designed and built the image velocity compensating system, and by the Bill Jack Scientific Instrument Co. and Hycon Manufacturing Co.

In spite of the complexity and sensitivity of the photo gear in the RF-

Testing Harness Checks Out F-105D Circuits

Republic Aviation engineers can check out 3,600 electrical circuits on the F-105D using the specially-developed testing harness. Prefabricated bridge-like frame houses a battery of automatic circuit analyzers; aircraft has more than 170 mi. of wiring.

THEY RELY ON RADIATION

for missile range instrumentation

In 1956, the Air Force called for a major advance in antenna design to instrument the Atlantic Missile Range. The requirements: long-range automatic tracking of missiles in flight.

Radiation met the challenge with what was then a bold new concept in range instrumentation. The heart of the imaginative new system was a 60-foot automatic tracking telemetry antenna. The antenna's gain was so high that it permitted reducing the number of proposed down-range island stations from ten to three.

Substantially exceeding Air Force requirements, these antennas have paid dividends in priceless experimental data from Vanguard, Pioneer, Explorer, and Tiros.

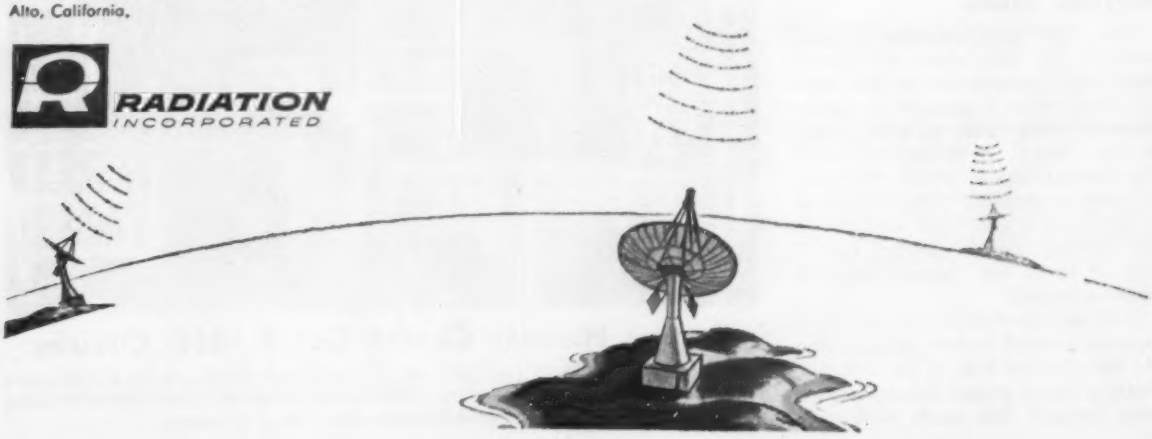
Two of the antennas were delivered to the Pacific Missile Range to meet an accelerated launching schedule.

RADIATION is a leader in space electronics. The Company has originated, developed and produced complete antennas and communication systems for NASA, ARPA, FAA, the Air Force, Army and Navy. Radiation designed and built the antenna at Kaena Point, Hawaii, and modified the Ft. Monmouth antenna for the Tiros weather satellite project. The Tiros FM transmitter is another product of Radiation.

If you'd like more information about us, write for our latest capabilities report. Address: Radiation Incorporated, Dept. AW-6, Melbourne, Florida.

Radiation's plants are at Melbourne and Orlando, Florida; Mountain View and Palo Alto, California.

RADIATION INCORPORATED



101C, there were no camera malfunctions during any of the Royal Flush Five missions.

This flawless record was also matched by the airplanes, which never aborted a sortie. The only trouble experienced by the Wing was that the tires had improper tubes installed, and the tubes were crimping inside the tires. This meant that a Voodoo made two landings and then went in for a tire change. At the end of the exercise, when some practice missions were planned to check new equipment, the Wing canceled the missions and grounded the planes until new tubes were flown in.

Solid Lubricants Have High Load Capacities

General Electric will produce a series of new solid lubricants that are said to have 20 times the load-bearing capacity of pure molybdenum disulfide. Improved load bearing capacity is obtained by adding approximately 10% by weight of various inorganic sulfides to molybdenum disulfide and tungsten disulfide lubricants. Most effective additives investigated to date are the sulfides of antimony, lead, mercury, platinum, silver and titanium.

Fire-Fighting Truck Uses Turbojet Engine

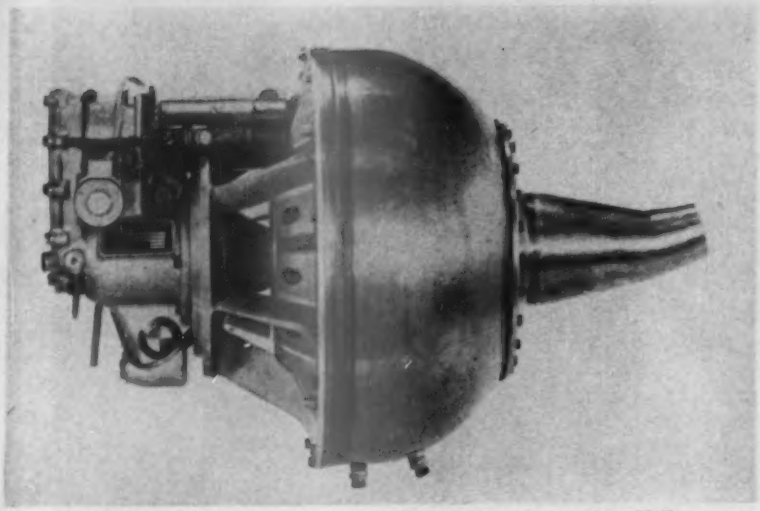
London—Novel fire-fighting truck demonstrated at National Gas Turbine Establishment, Pyestock, England on May 24 uses a gas turbine to generate inert gas which saturates the fire zone. Turbojet is fitted with reheat (afterburning) and water is injected into the exhaust, greatly augmenting the supply of inert gas.

Gas turbine is a standard Bristol-Siddeley Viper turbojet mounted on a five-ton truck. Turbine has an air mass flow of 25.2 lb./sec. and water at the rate of 14 lb./sec. is fed into the jetpipe by air driven turbo-centrifugal pumps supplied from the engine compressor.

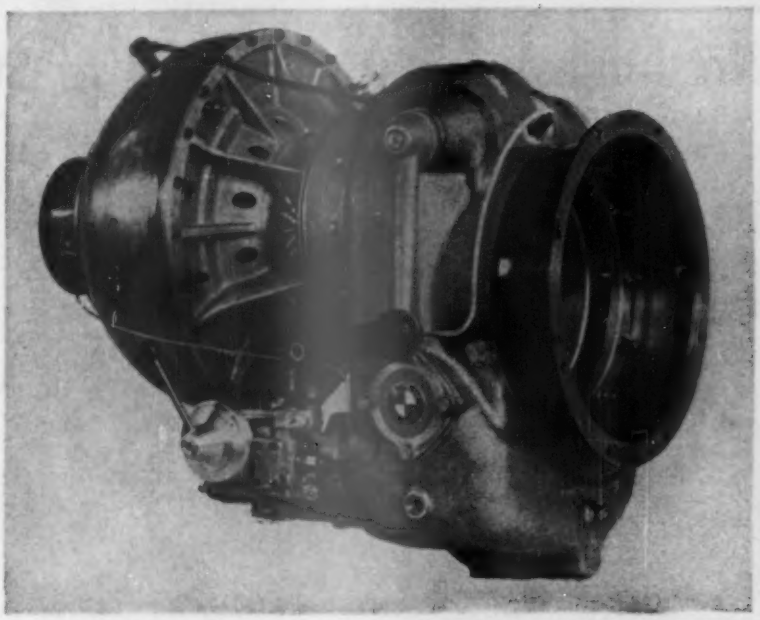
Corresponding volume flow to the fire zone is 50,000 cu. ft./min. of free gas at 120C containing less than 5.1% by volume of oxygen. Output temperature of the effluent is governed by the need to deliver the gas through flexible piping.

Inert gas supplies of this order, according to the British Fire Research Station, Borehamwood, would prove a much more effective fire-fighting medium than water in cases of very large fires which, although infrequent, account for the great proportion of total fire damage.

The technique would also reduce water damage.



GERMAN BMW 8025 takeoff thrust is about 79 lb. but can be raised to 93 lb.



BMW 6002 gas turbine has been uprated to 65 hp. at 45,000 rpm. under full load.

BMW Jet Develops 79 lb. Thrust

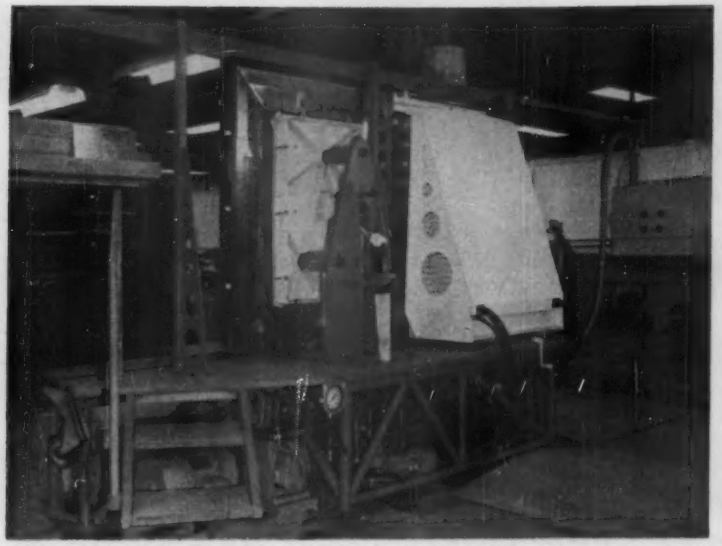
Hanover, Germany—New BMW 8025 small gas turbine developed by BMW Triebwerkbau GmbH., Munich-Allach, is based on the company's BMW 6002 portable gas turbine powerplant introduced last year.

The 8025 has a dry weight of 77 lb. Takeoff thrust is approximately 79 lb. which, without any change in basic engine weight and dimensions, will be increased to about 93 lb.

The engine is fitted with an electric starter and operates on any standard fuel, but for economy and safety the use of light fuel or diesel oil is recommended. Fuel also is used for lubrication. Prototype of the BMW 8025 was shown for the first time at the Hanover air show.

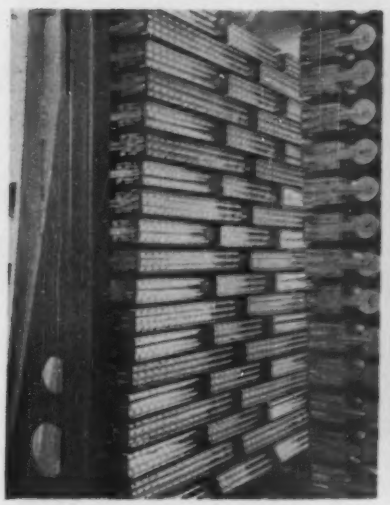
Rating of the BMW 6002 gas turbine has been increased from 50 shp. to 65 shp. at 45,000 rpm. under full load. Output shaft rpm. of the 6002 can be reduced from 11,000 to 3,000 rpm. by gearing.

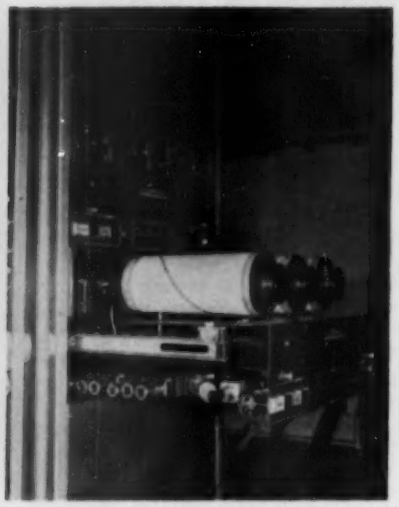
The engine can be started with a hand crank or electric starter. Over-all length is 30 in., diameter is 27 in.



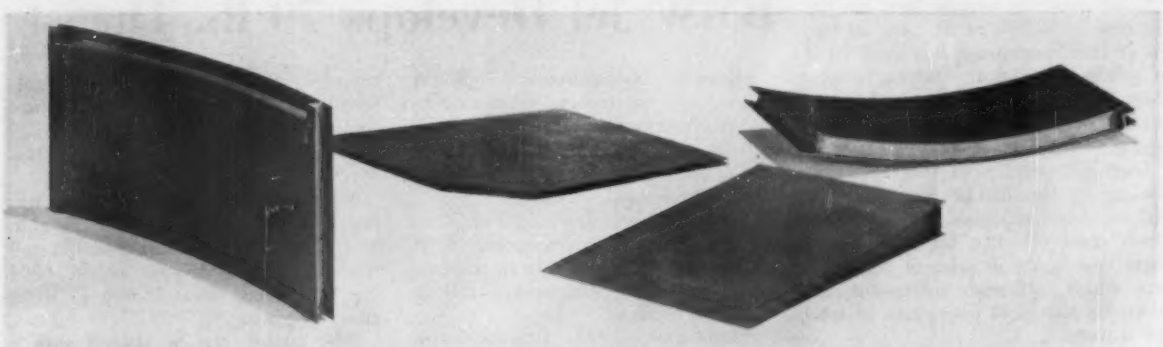
Stainless steel panel is held in an airtight envelope in chill position (left) after having been brazed at 6,000F between electronically-controlled banks of radiant quartz lamps at Northrop Corp.'s Norair Division, Hawthorne, Calif. At right, the honeycomb panel is in its brazing envelope in the load-unload station on Northrop's Nortobraze machine.

Northrop Automates Brazing of Steel Honeycomb





Banks of radiant quartz lamps (left) can be energized and controlled selectively for brazing various panel shapes and sizes. Six-channel console (center) is production and temperature control center in Nortobraze system. Programmers (right) scan a time-vs.-temperature plot to provide automatic temperature control. USAF awarded Northrop a $946,447 contract to adapt process to manufacture of advanced aircraft and space vehicles. Process may eventually replace present 3 to 12 hr. furnace brazing methods.



Nortobraze has been applied to titanium alloys and is adaptable to metals in the columbium and molybdenum groups, Northrop says.

PRODUCTION BRIEFING

Plastics Division of Teco, Inc., has begun operation in a recently completed facility manufacturing the molded and form-fitted "Mason Modular Chair", designed for business, private and commercial aircraft. Items such as baggage containers, reusable electronic shipping containers and other industrial and commercial products will be integrated into a product line in the Plastic Division.

Solar energy converters for the National Aeronautics and Space Administration's forthcoming lunar probe with one-third greater efficiency than those used in previous space probes will be fabricated by Hoffman Electronics Corp.'s Semiconductor Division under a $548,000 contract with California Institute of Technology Jet Propulsion Laboratory. Contract calls for 12 panels mounting a total of 50,000 silicon solar cells with a light-to-energy conversion efficiency of 12%. Each solar panel will have a power output of 95 watts.

Canoga Division of Underwood Corp. has received $3 million in antenna, instrumentation and component contracts during the first four months of its current fiscal year. This compares with a $3.5 million total volume for the entire FY 1959. Current contracts, including research, development and fabrication for Project Mercury, the Air Force, Republic Aviation, Raytheon, Lockheed and the Navy, cover ground instrumentation antennas, microwave components, distance measuring equipment, data link and data processing systems, timing equipment, aircraft instrumentation and radar safety systems.

A thermostatic switch, located in the turbine exhaust stream and providing for automatic ignition in the event of turbine or turboprop engine flameout, now is available in the AiResearch Phoenix line of engine controls. Switch remains open at normal turbine exhaust temperatures within a range of 1200F to 400F but if temperature drops suddenly below about 400 F, the circuit automatically closes, cutting in ignition. Automatic reopening of the circuit is provided once ignition has been accomplished. System provides the same restart capability as continuous ignition but eliminates the expense and overhaul problems associated with the latter, according to AiResearch Mfg. Division, of Garrett Corp., system producers.

U. S. Science Corp., Los Angeles, will automate photo control systems for the Grumman AO-1 observation aircraft under $250,000 contract. The photo-control devices permit mapping without pilot operation.

AIR FORCE RECRUITERS PUT CESSNA U-3A SUPPORT PROGRAM TO THE TEST. Their work at a small midwestern university done, two Air Force recruiters prepare for take-off—only to find that their battery, beset overnight by sub-zero cold, has gone dead. Course of action: Requisition the nearby Cessna distributor (U-3A supplier) for a new U-3A battery, be airborne by noon. A simple thing. Made possible by a nationwide off-the-shelf support program growing out of Cessna's support of the U-3A's commercial counterpart, Model 310, and conceived by Cessna to do for the Air Force what it would find prohibitive to do itself.

CESSNA

Wichita, Kansas

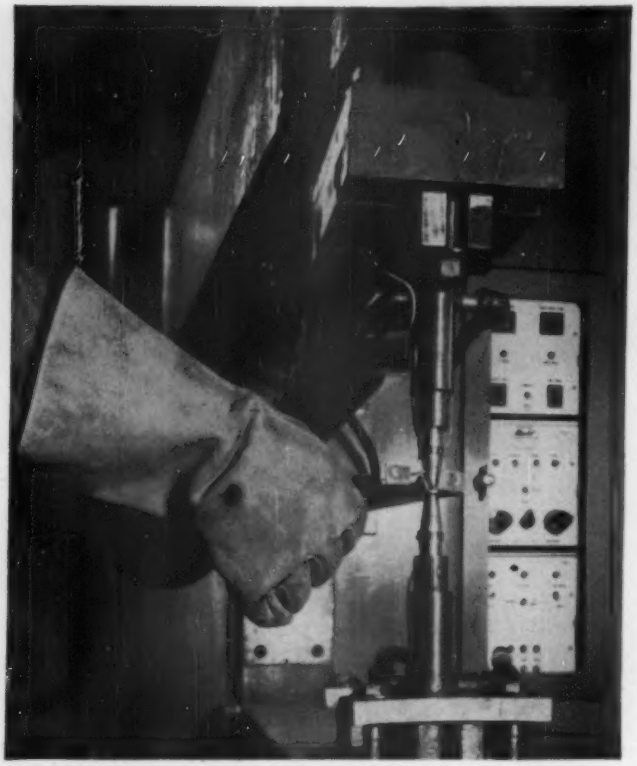
FIREPROOF

...with Skydrol-resistant cover

Construction: Fluoroflex®-T tube, AISI Type 304 stainless steel wire braid, specially impregnated asbestos shield which resists hydraulic and cleaning solvent fluids. Dash 4 through −24Z with swaged type or Seal-Lock® reusable fittings. ®Trade Mark

dept. 310 RESISTOFLEX Corporation, Roseland, N. J.

NEW FEEDBACK CONTROL
makes every weld count

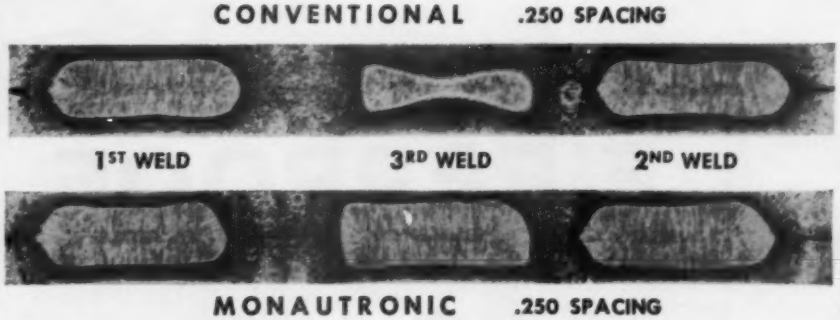


Information from electrodes is fed back to **Monautronic V-2** in background. Control has fully automatic sequencing with all provisions for single spot, roll spot and seam welding.

Now, with the new **Monautronic V-2** welding control, you can make consistently top-quality welds over long stretches of time, without stopping to test and inspect sample welds. The control senses variations in line voltage, electrode shape and tip force, material thickness and surface finish . . . and compensates for them immediately.

The **Monautronic V-2** automatically compares actual voltage across the weld with command voltage, and adjusts current accordingly to maintain voltage—and weld quality—at a constant level. If weld resistance is too high or too low to produce a good weld, the control locks out until the condition is corrected.

Although the **Monautronic V-2** embodies the latest advances in computer-type circuitry, it is quite simple to operate, and easier to maintain than most conventional controls. For complete details, contact THE BUDD COMPANY, Electronic Controls Section, Philadelphia 32, Pa., or one of our regional offices.



The **Monautronic V-2** overcomes shunting effects by maintaining constant voltage across each weld, regardless of how closely spaced the welds may be. Photomacrographs compare closely spaced welds made with conventional control with those made with **Monautronic V-2.** Notice how shunting of voltage has weakened the center weld made with conventional control, while **Monautronic V-2** has kept all welds uniform.

ELECTRONIC Budd CONTROLS

2450 Hunting Park Ave.
Philadelphia 32, Pa.

12141 Charlevoix Ave.
Detroit 14, Mich.

3050 East 11th St.
Los Angeles 23, Cal.

Reflectors Cut Solar Power Unit Weight

Pasadena—Combining a lightweight solar concentrator and photovoltaic cells, a space power supply system which can develop the same wattage at 0.7 the weight of a conventional solar panel has been developed by Electro-Optical Systems, Inc.

The straightforward system uses available production silicon cells and the EOS-developed concentrator. Since it represents an intense engineering refinement of known techniques rather than any breakthroughs, hardware should be available for the first flight date, which is projected for June, 1961. System is being developed under contract from Wright Air Development Division, although EOS did much early analysis and engineering on its own.

EOS design approach accepts the inherent reduced efficiency of individual solar cells when they work at higher temperatures, but obtains a higher total power output, using the reflector, than a panel of the same size without reflector could produce. Thus, while individual cells are working less efficiently, they furnish a greater total power from the higher illumination level, yielding a system which is more efficient in terms of watts per square meter of panel area.

Cell Efficiency

For its prototype systems, EOS will use silicon cells which are about 12% efficient at room temperature, but drop to less than 9% at the 130F temperature level where the panel-with-concentrator operates. During system development, EOS expects more efficient silicon cells will become available.

Although several concentrator shapes are capable of keeping the higher level of illumination spread almost evenly over panel surface to minimize concentrations, EOS is assembling its first prototype units using flat plate reflectors as concentrators, which are fabricated of aluminum foil mounted on light frames. These can be folded for launch and spring opened to the desired position once the vehicle has reached space, and will be used on early flight systems.

Heat Rejection Problem

While simple and reliable, solar cell space power supplies face an inherent heat rejection problem. The concentrator aggravates the situation, since while raising illumination level it also increases heating above the normal solar constant of 1,400w./sq.m. which applies at earth orbit distances from the sun. For prototype and early systems, EOS will use higher emissivity coatings on radiating surfaces as one approach to heat rejection.

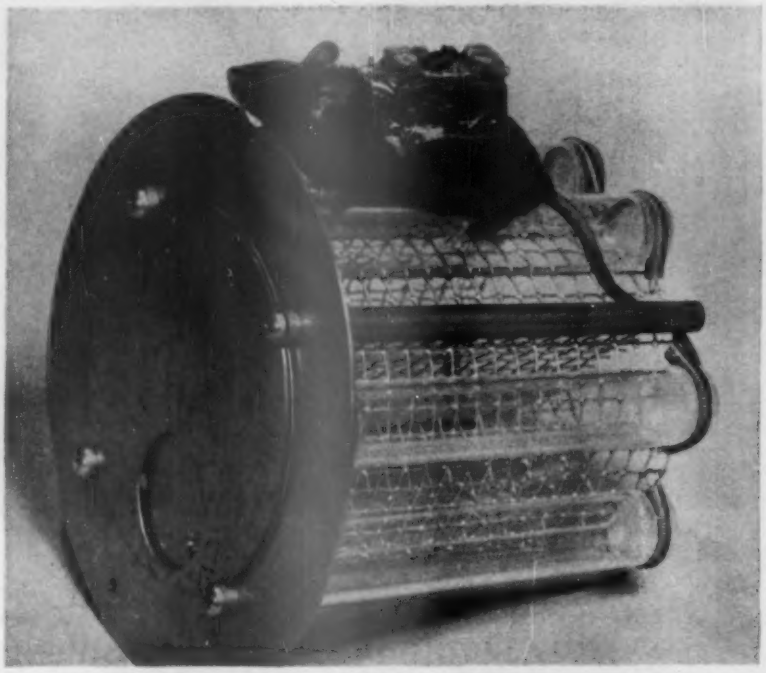
A second approach will have spectrally selective filter coatings used on silicon cells, to reflect as much as possible of the infrared and ultraviolet radiation spectra which contribute nothing to power output but increase heat inputs. Filters are designed for space environment rather than earth, where atmospheric attenuation significantly changes radiation characteristics.

Another solar cell problem is high energy proton radiation encountered in the Van Allen belt, which can put an unprotected solar panel out of commission in a week or less. Primary damage from this radiation is alteration or destruction of the crystal lattice structure of solar cells, cutting off electron flow and power output. Radiation also causes a degree of sputtering on the cells. A 50 mil thick glass plate will be used in early flight systems as protection against this radiation.

First refinements in the flight systems will involve different concentrator shapes, after which better filters will be sought; finally, better materials for the cells should be developed.

Although flat plate reflector-concentrators are easiest to fabricate, other configurations can obtain substantial gains in system performance in combination with EOS design techniques, such as a partial cone shape. However, the key elements in concentrators are to get necessary rigidity, maintain highly critical reflecting surface shape tolerances, and light weight.

EOS reflectors consist of a reflective coating, a skin, and the skin support. The company has developed a proprietary fabrication technique for these, whereby skins a few mils thick are

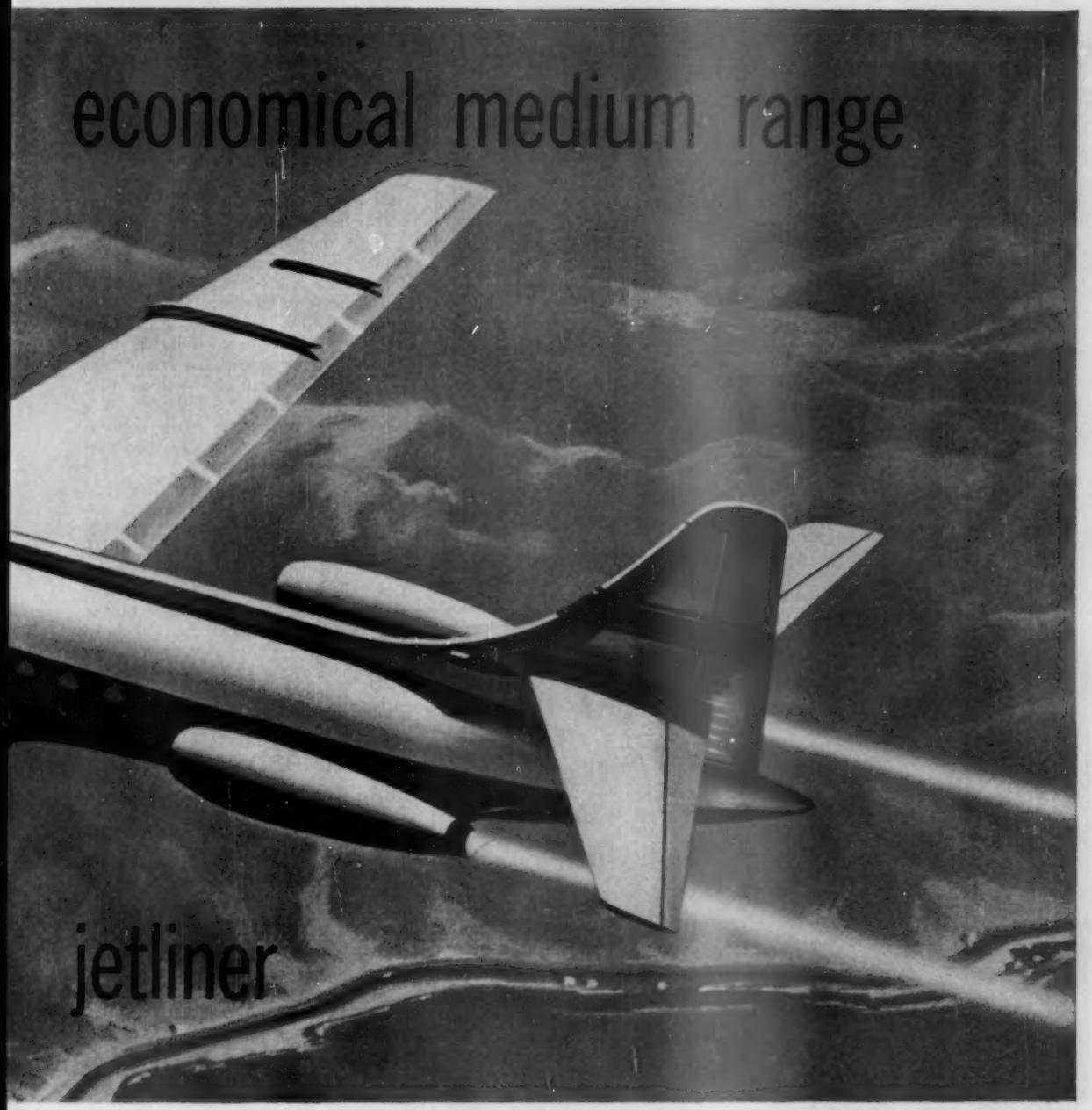


Radio-Equipped Mouse Atop Space Cage

Biopack for mice to be installed in space-bound rockets was designed and built at USAF School of Aviation Medicine, Brooks AFB, Tex. Atop the biopack, which can sustain four mice in space for three days, sits Flash, one of the subjects used in tests, carrying a miniature radio transmitter, weighing 20 grams. A mercury battery, about the size of a shirt button, supplies power. Range of the transmitter is approximately three feet and it sends the minute electrical potentials from the mouse's body to the satellite's telemetering system. The special cage restricts the subjects' movement and prevents injury due to buffeting during blast-off. Cage also contains oxygen metering equipment, carbon dioxide and water absorption units and a food supply.

Now sold and serviced
by Douglas, Sud Aviation's
Caravelle offers
jet transportation on routes
impractical for the long range jetliners

Designed and built by **SUD AVIATION**



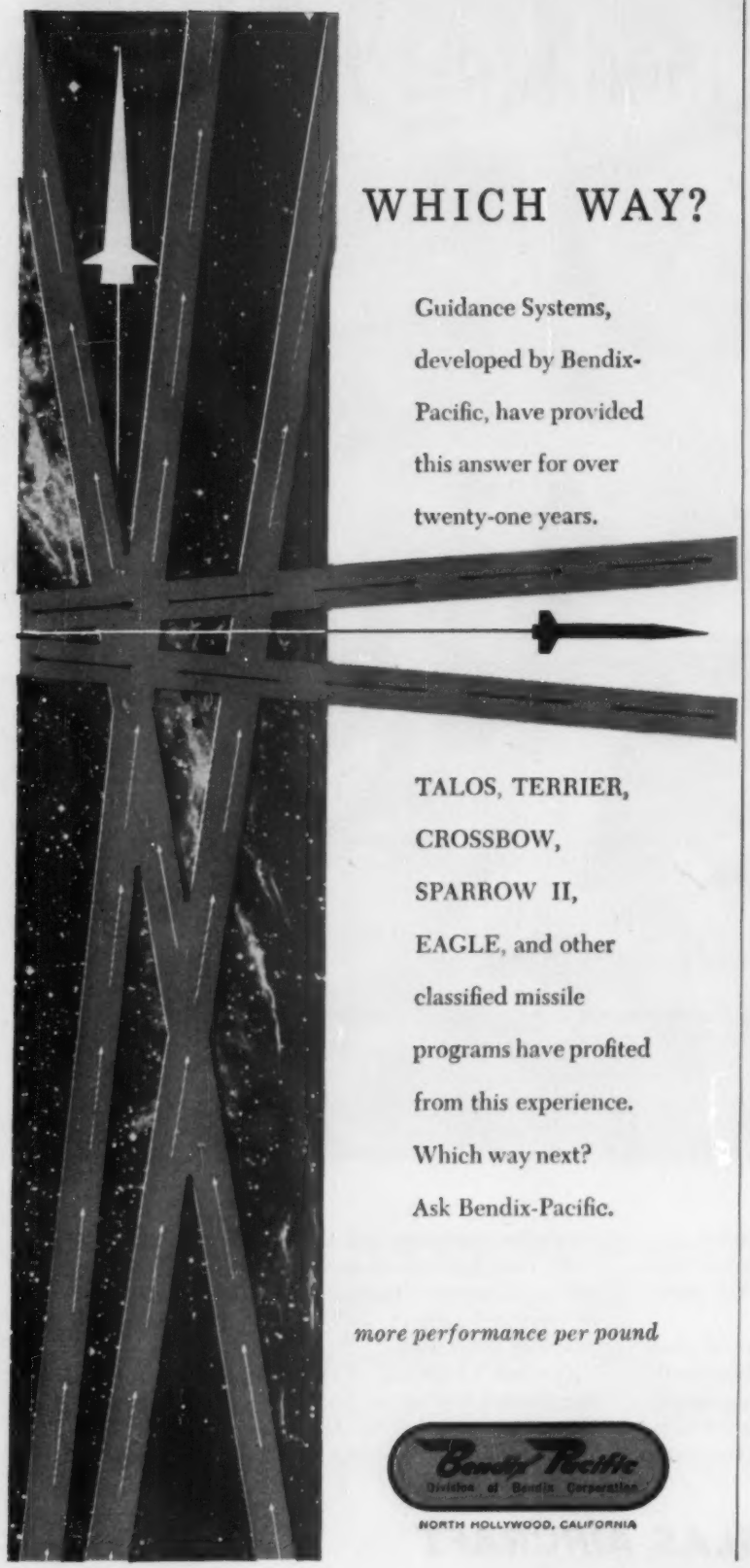
After exhaustive investigation and testing, the Douglas Aircraft Company can recommend Sud Aviation's *Caravelle* jetliner as the world's finest medium range airliner.

This luxurious jetliner—C.A.A. approved—has been manufactured and tested in accordance with the most modern techniques. *Caravelle* has proved in more than a year of airline operation overseas that it is outstanding in performance, economy, ease of maintenance and passenger acceptance.

Its rear fuselage-mounted twin engines put the jet exhausts behind all passengers, resulting in aviation's quietest cabin. Stability is excellent, vibration non-existent.

Caravelle's high rate of climb and high cruising speed make it ideal for routes from 200 to 1400 miles. It is an aircraft that fits the Douglas tradition ...dependable, durable, and an airline profitmaker.

***Sold and serviced by* DOUGLAS AIRCRAFT**


WHICH WAY?
Guidance Systems, developed by Bendix-Pacific, have provided this answer for over twenty-one years.
TALOS, TERRIER, CROSSBOW, SPARROW II, EAGLE, and other classified missile programs have profited from this experience. Which way next? Ask Bendix-Pacific.
more performance per pound
Bendix Pacific
Division of Bendix Corporation
NORTH HOLLYWOOD, CALIFORNIA

formed to the required shape, after which the supporting structural material is attached or applied.

Skins are made of aluminum, beryllium and nickel, and spinning, stretch forming, electro forming and andro forming are used. Supporting materials include plastics which are foamed into place and harden. Critical aspect is retaining shape of the skin while support is being attached.

High reflective coating is vacuum deposited aluminum.

A natural characteristic of solar cells is a decrease in efficiency with increase in temperature. In surveying new cell materials, EOS looks closely at the slope of the curve representing efficiency decay rate. Company also believes that efficiency at elevated temperature is a very important criteria when concentrators are used, rather than performance at room temperature.

Two cell materials being developed are gallium arsenide and cadmium sulfide. Production cells of these materials are available now which operate at 3½ to 4½ efficiencies. However, laboratory cells have been made which work at 8½ efficiency, and the slope of the performance decay curve shows them to become superior to silicon at temperatures above about 175C. It is expected to be three to five years before this quality is obtainable in production cells.

World Astronautics Academy Planned

International Academy of Astronautics will be formed as a part of the International Astronautical Federation and will be financed for the first three years by the Daniel and Florence Guggenheim Foundation.

The academy will be set up to advise the president of the International Astronautical Federation when requested, to hold scientific meetings and make scientific studies and reports, to publish an international technical publication on astronautics and to award medals and prizes to further astronautic progress.

The French government has agreed to provide quarters for the academy in Paris at no charge. The academy is expected to be formed in August at the Stockholm meeting of the International Astronautical Federation.

Goodrich-High Voltage To Build Ion Engine

Goodrich-High Voltage Astronautics, Inc., Burlington, Mass., will develop and fabricate a demonstration-type space propulsion engine utilizing an arc-type ion source. The ion thrust engine will be developed for Wright Air Development Division.

Schlieren System Set for Mercury Tests

Hawthorne, Calif.—Multiple slit, sharp-focusing schlieren system is undergoing final tests prior to shipment to McDonnell Aircraft Co.'s polysonic wind tunnel where tests are under way on Project Mercury space capsules.

Advantage of a multiple over a single slit system is that it can be used in a transonic test section having perforated walls for boundary layer bleed, according to Northrop Corp.'s Nortronics Division, developer of the system. McDonnell's facility has a velocity range from the transonic region to Mach 6 and the boundary layer bleed walls of the operating transonic section are comprised of 0.625-in.-thick steel with 0.375-in.-diameter holes, giving the walls a 25% porosity.

In addition to the obscuration caused by the boundary layer bleed walls, the outer walls of the test sections have 3-in.-wide mullion supports for six 15-in. x 15-in. window panes. Nortronic's schlieren system can be shifted for complete coverage of the window area over a 33-in. x 51-in. range.

Suitable for use in both the supersonic and perforated wall transonic sections, the system is sharp-focusing over a plus or minus one foot range from the center of the test section span. The field of view at the tunnel centerline is 18 in. in diameter and is free of vignetting or fall-off in illumination at the edges of the photographs.

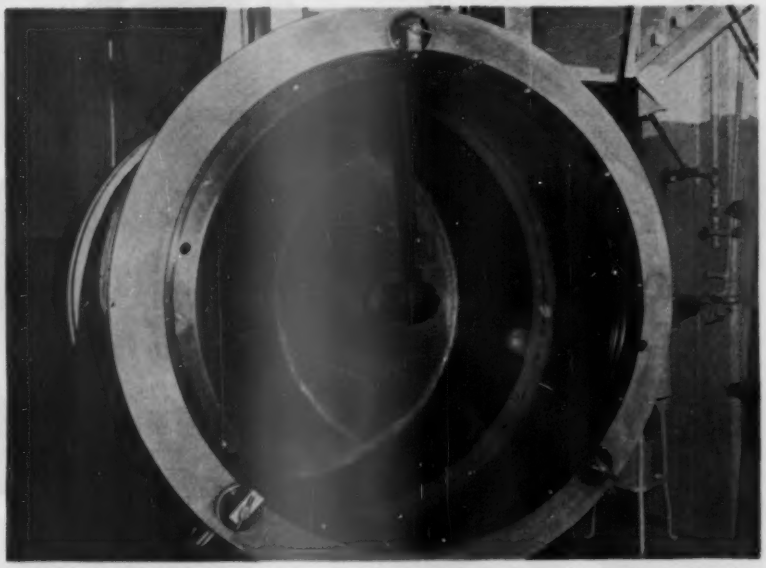
Working sensitivity range is between 20 sec. of arc and 2 deg. of angular deflection with a high sensitivity limit of 6 sec. of arc.

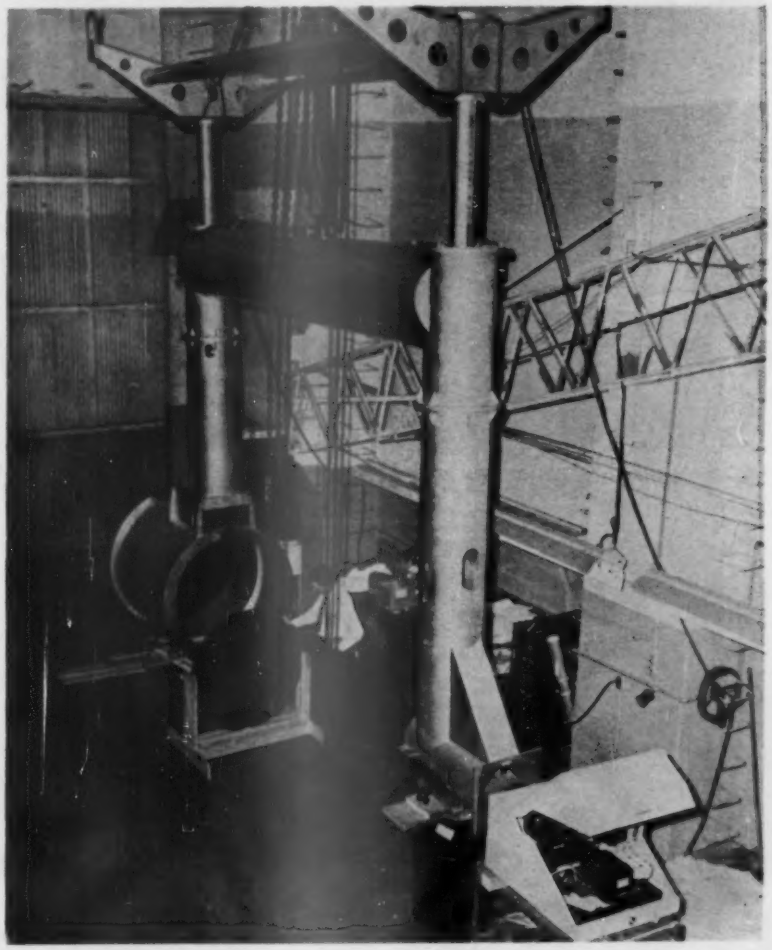
Because of problems encountered in obtaining a firm footing for the entire tunnel in the site selected by McDonnell, the 7,000-lb. schlieren system is suspended from the tunnel overhead crane rails and is isolated from building vibration by integral coil springs.

The massive structure is necessary to maintain optical alignment of the light source and camera assembly. Mounting on the overhead crane rails also permits the entire system to remain in alignment with the tunnel building.

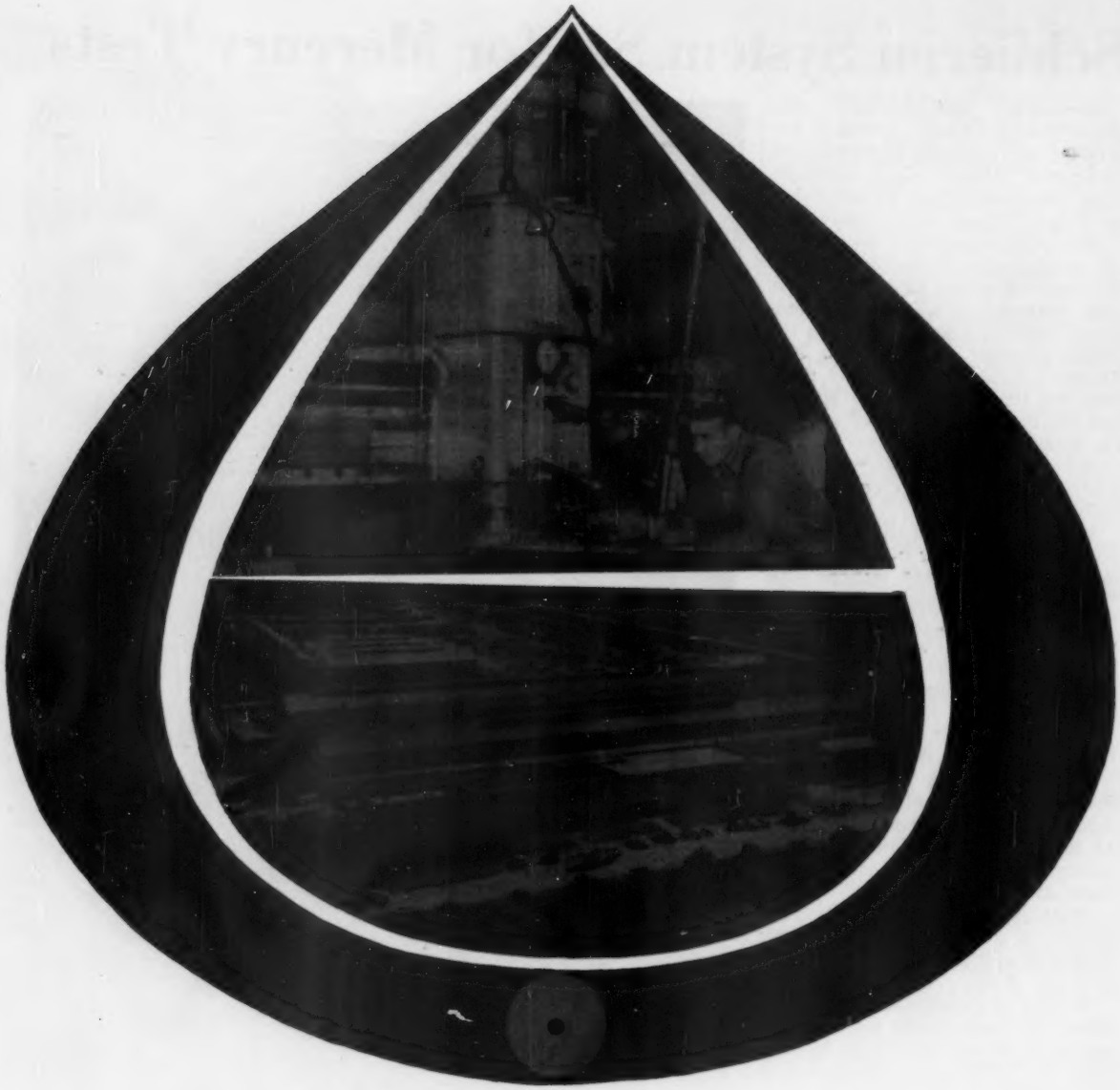
Operational requirements met by Nortronics for the McDonnell tunnel are as follows:

- **Shift from a 70-mm.** Hulcher camera to a 16-mm. Fastair camera can be accomplished in one second. During a 30-sec. to 120-sec. duration test run, cameras can be shifted and independently actuated remotely from the control room console.
- **Relocation of the system** to an alternate test section can be done within the 30-min. interval between test runs while the blowdown tanks are recharged. During this time interval, the





STROBE LAMP and reflector (above) are shown through the multiple slit source plate. Below, schlieren system is shown in assembly and checkout before shipment to McDonnell.



VERSATILE METAL FABRICATION geared to the Southwestern space-age industries

Youngstown's Continental-Emsco Division has over 77 acres of metal fabricating facilities . . 336,505 square feet under roof, convenient to the many Southwestern electronics and air frame manufacturers. This fully integrated plant places at your disposal a competent, creative engineering and R&D staff; batteries of precision gear cutting machines; flexible equipment for milling, turning and boring and spacious bays for all types of metal fabrication and assembly. Plant quality control qualifies for MIL-Q-9858. Put this capable plant to work for faster deliveries . . higher quality . . lower cost. Write, wire or call today.

CF-502

METAL FABRICATORS FOR INDUSTRY

CONTINENTAL-EMSCO COMPANY

GENERAL OFFICES: DALLAS, TEXAS • P. O. BOX 359 • PLANTS: HOUSTON, GARLAND, TEXAS; PASADENA, CALIFORNIA

A DIVISION OF THE YOUNGSTOWN SHEET AND TUBE COMPANY

system focus for monitoring and film recording over the entire useful test section span can be accomplished plus relocation of the system to an alternate section, as well as complete translation shift to either section plus adjustment and reloading of cameras.

A continuous closed-circuit television system is incorporated for continuous monitoring during the tests, simultaneous with recording by either of the two cameras. The larger 70-mm. camera has an exposure rate of one to five frames per second while the 16-mm. exposure rate is from 10 to 300 frames per second. Light source is a zeon flash tube strobe light with modified housing. One flash frame is provided while either of the cameras is photographing and 20 flashes per second are provided for the TV camera monitor. A grating circuit interrupts the 20 per second flash as each frame is exposed by the Hulcher camera. While photographing with the Fastair, the 20 per second rate is replaced with one flash per frame.

The source plate is 42 in. in diameter with 500 parallel lines, .041 in. wide and spaced .041 in. apart. Lines and spacing are accurate to within plus or minus .001 in. The source plate was made by Nortronics by applying a pressure sensitive opaque tape to a ½-in.-thick glass plate and cutting the tape with a specially adapted jig boring machine. Alternate strips were removed and a ½-in.-thick glass plate cover applied to form a sandwich.

The ellipsoidal reflector has a 52-in. clear aperture, is formed by laminating glass fiber with a high temperature epoxy over a plaster negative. The surface is vacuum-aluminized and lacquer-coated for abrasion and oxidation resistance.

The control panel is designed for operation with only one actuation switch with either camera. The strobe firing pulse automatically is switched to provide the proper rate. A function display of illuminated buttons of different colors is supplied.

Calibration for deviation versus density is by use of a standard counter-rotating wedge prism, reported to make this the only schlieren system so calibrated.

Space Lab Would Orbit, Return Scientists

Dallas, Tex.—Manned space laboratory, capable of supporting three scientists and 673 lb. of test payload, developed on a modular concept permitting maximum utility of the basic concept for numerous other space missions to lessen costs, has been conceived by a pair of engineers of Chance Vought Aircraft's Astronautics Division here.

Engineers Robert H. Lundberg and Tom E. Dolan believe that their concept could be placed into orbit within six years.

Concept provides for a space laboratory and separate re-entry vehicle, the former remaining in its 300-mi. orbit, while the latter is used by personnel for return to earth. Both would be launched into orbit by a Saturn booster.

Five-Year Schedule

Detailed funding analyzed for the system by Lundberg and Dolan on the basis of best knowledge obtainable indicates that expenditure for such a program would total some $9.8 million; of this nearly three-quarters of the expenditures would be of a non-recurring nature. Basing the development on a five-year schedule, they say maximum fiscal year funding annually would be $284.7 million. This, they believe, fits the project realistically into current national space programing.

The system proposed utilizes a modular concept of separate re-entry vehicle and space station—designated Satellab. The upper and lower fan-shaped lightweight structures on the sun-oriented vehicle would support solar cells to provide 5.5 kw. of electrical power for the Satellab.

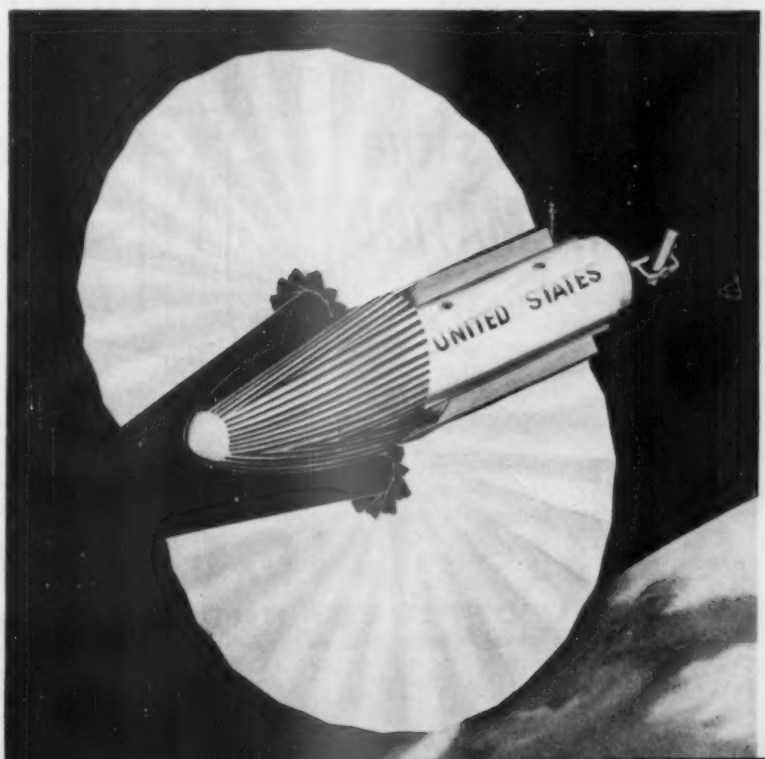
Lundberg and Dolan base the vehicle's 300-mi. orbit on the fact that this would represent a true space environment while also avoiding major exposure to the hazardous radiation in the Van Allen radiation belt. Station is designed to support three men for 14 days. To return, the trio would leave the Satellab for the re-entry vehicle, a lifting maneuverable body, separate from the laboratory and make a point return to a preselected landing site on earth.

The space laboratory has a total weight of 10,090 lb., with re-entry vehicle weighing 5,750 lb. and the Satellab weighing 4,340 lb., including 673 lb. of test and associated equipment.

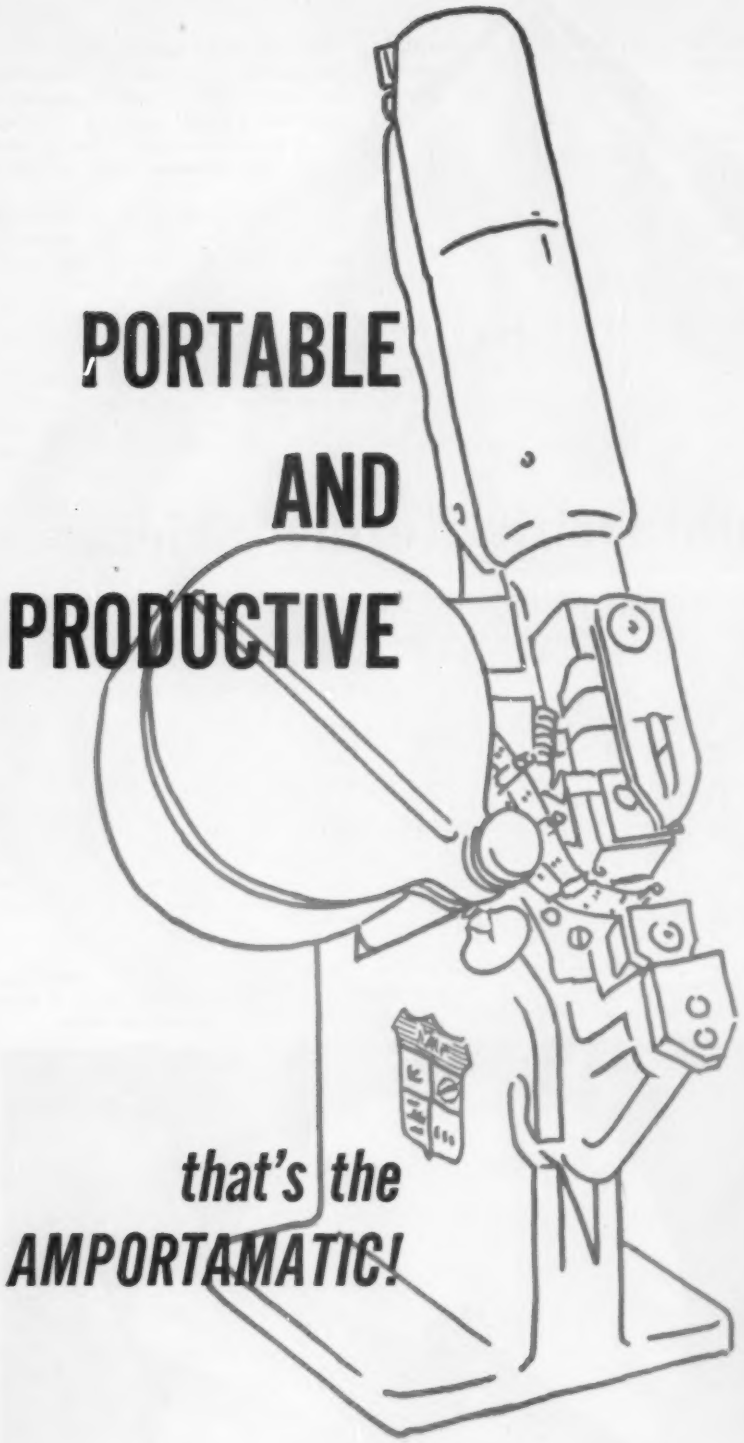
The approximate $9.8 million cost for the program would include 17 entry vehicles and nine Satellabs. Costs would include:

- **$12.1 million** for a combination Satellab and re-entry vehicle. A second complete assembly would cost $27 million, including booster and launch operation costs.
- **$255,600,000**, the largest cost item in the program, would be expended on engineering effort. All testing would amount to $237,700,000.
- **$49,300,000** would have to be expended on research and development: $30 million on crew training, $55.5 million on range modification; $39.2 million for tooling and $32.3 million each to be spent for spares and equipment.

THREE-MAN SPACE STATION proposed by Chance Vought Aircraft Astronautics Division engineers has large, sail-like structures mounting solar cells to provide electrical power for the sun-oriented vehicle. Concept shown would support men for two weeks.



PORTABLE AND PRODUCTIVE



that's the AMPORTAMATIC!

If your production problem puts you squarely in the middle of not ready and not yet—quotas too high for hand tool crimping yet not high enough to justify installation of AMP automatic machinery—you'll find a minimal investment, speed-up answer in the AMPORTAMATIC Tool.

The AMPORTAMATIC Tool is designed for continuous use to precision crimp a variety of AMP terminal types in a wide wire size range. For volume, bench production or for hard-to-reach locations—anywhere along the production line—the AMPORTAMATIC Tool delivers a single crimp or a fast series of crimps with complete reliability.

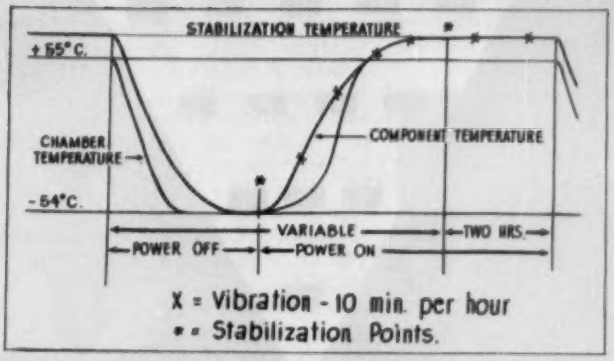
Think there's room for this versatile performer in your lineup? Then you'll want to know more about the portable AMPORTAMATIC Tool.

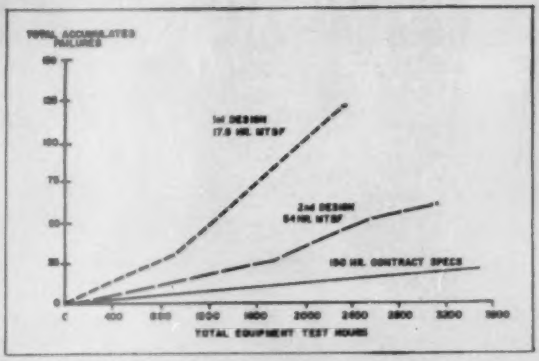
Send for the full story today!

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • West Germany





TEST CYCLE for AGREE reliability tests includes three-hours-plus temperature stabilization time at elevated temperatures with power on, followed by a similar period at cold temperatures. Equipment is subjected to 10 min. vibration every hour during tests. Shown at right are AGREE reliability test results on an ARN-21C Tacan set. It is the first complex avionic equipment to undergo such rigorous tests. Two redesigns were required to reach the 75-hr. mean-time-between-failure (MTBF) period. Air Force then released sets for field use, but required company to increase the MTBF after producing 1,000 sets.

USAF Expands Use of Reliability Tests

By Philip J. Klass

Dayton—Air Force is rapidly expanding its use of the "get tough" reliability tests, developed several years ago by the Defense Department's Advisory Group on Reliability of Electronic Equipment (AGREE).

The Aeronautical Systems Center here, which pioneered in the application of AGREE tests to avionic equipment procurements, now has the provision included in nearly 40 contracts in being or under negotiation, according to Col. Edward McKaba, chief of ASC's Communications and Reconnaissance Division. Except for bombing-navigation systems, this division buys most of USAF's airborne avionics equipment.

Tests on the new Hoffman Electronics Corp. ARN-21C Tacan navigation set, first complex equipment built to the AGREE reliability specifications, has demonstrated a mean-time-between-failure (MTBF) in factory tests which is four times the figure for earlier ARN-21B equipments.

Careful Monitoring

First of the ARN-21Cs to be installed in operating squadrons will be monitored under a carefully controlled test program to determine the equipment's actual MTBF in field use in order to correlate this figure with the MTBF obtained in factory tests. Air Force also seeks data on the specific types of failures that occur in the field to determine whether they are the same as those found in factory AGREE tests.

Preliminary indications are that the AGREE tests are much more severe than actual field use and that the ARN-21Cs should operate for several times the mean-time-between-failure figure experienced in the factory tests.

Under the terms of the original ARN-21C contract with Hoffman, the sets were required to exhibit an MTBF of 150 hr. when subjected to AGREE tests. The earlier model ARN-21B sets exhibited an MTBF of only 17 hr. when subjected to the same tests.

With two equipment redesigns and several years of reliability improvement effort, Hoffman has been able to boost the mean-time-between-failure of the ARN-21C to around 75 hr. Air Force agreed to waive the 150-hr. figure for the first 1,000 equipments inasmuch as even this lower figure represents a 300% improvement in reliability.

For an aircraft whose typical mission lasts for three hours, a Tacan set with a MTBF of only 17 hr. has only a 75% probability of operating throughout the entire mission, whereas a set with a 75 hr. MTBF has a 96% probability of operating for the full mission.

Equally dramatic are the gains expected in maintenance costs. A Tacan set with a MTBF of only 17 hr. will cost approximately 15 times as much to repair and keep in operating condition as one with a 75-hr. MTBF, according to Air Force estimates.

Col. McKaba told Aviation Week that his division carefully briefs prospective Air Force bidders on the details of the AGREE tests and warns them of their severity. The consequence of failing to meet the tests can be costly to a company.

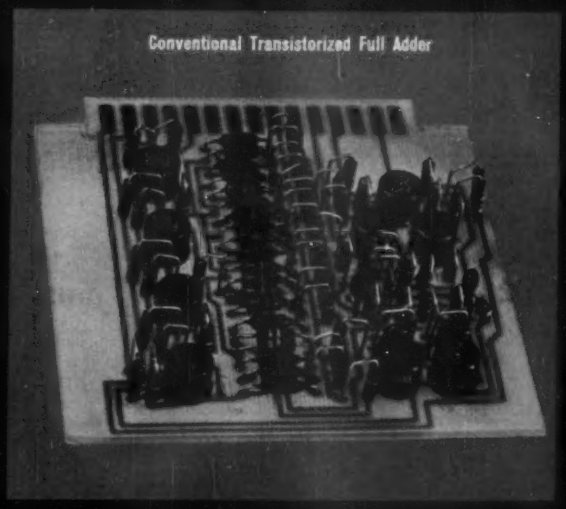
In the original competition for the $46 million ARN-21C contract which Hoffman won, price was a major factor and bidders shaved their quotes to the bone. When Hoffman subsequently had to take a waiver on the 150-hr. MTBF in order to get Air Force to accept the sets, the company had to accept a downward revision in original contract price, McKaba says.

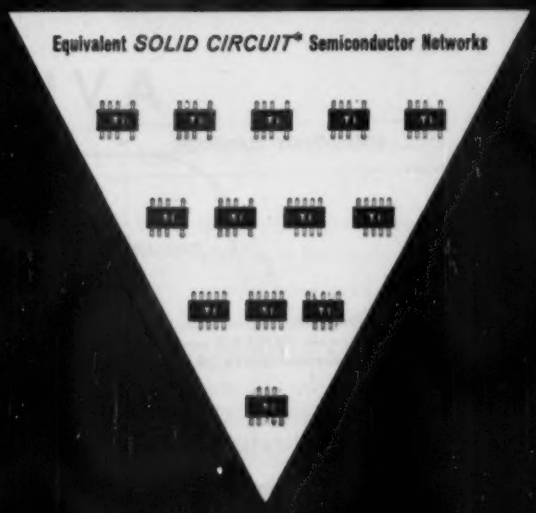
Test Problems

Hoffman's problem of getting the ARN-21C to pass the AGREE tests was made more difficult by the fact that the set was not originally designed to meet these stiff tests and the type of corrective action which could be taken in modifying the equipment design was limited by the fact that the ARN-21C had to be interchangeable with earlier models in the field.

Where equipments are designed from scratch with the AGREE reliability tests in mind, they are a less difficult hurdle, according to Capt. Stephen E. Schoderbek of ASC's Navigation Branch. He cites as an example the AN/ARR-60 and ARR-61 time-division data links, developed by Radio Corp. of America for use on the Convair F-102, McDonnell F-101B and Convair F-106. Preliminary tests to date indicate these equipments will have no difficulty in passing the AGREE tests.

In a recent competition for a transistorized instrument landing system receiver, which had to meet X-level (extremely severe) environmental test conditions, a company without previous experience with such equipment submitted a quotation that was about 25% less than the next lowest bidder. Before awarding a contract to the company, Air Force representatives talked to company officials to be certain they understood the risks and responsibilities involved. When the company said it did, and that it was intentionally under-

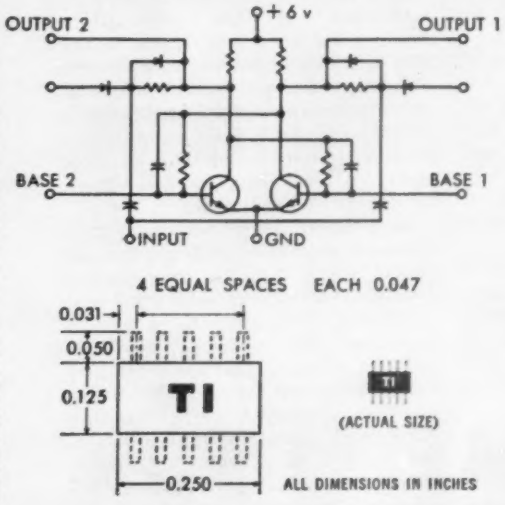




NOW MAKE YOUR OWN EVALUATION

Using one particular interconnection technique for semiconductor networks, this working full adder occupies 1/50th cubic inch.

TI Type 502 silicon **SOLID CIRCUIT** network is intended for binary counter, flip-flop, or shift register applications. Maximum repetition rate of 200 kc. Hermetic sealed package. Write for bulletin TI type 502.



SOLID CIRCUIT* semiconductor networks

Make your own evaluation today of ***Solid Circuit*** semiconductor networks from Texas Instruments. Available for immediate application, semiconductor networks integrate resistor, capacitor, diode, and transistor functions into single-crystal semiconductor material.

You get improved reliability through the elimination of individual components . . . element interconnections are reduced as much as 80% . . . size and weight are drastically reduced and power consumption is minimized.

To design more sophisticated systems in the same space and to increase your system reliability, evaluate the 100:1 miniaturization potential of semiconductor networks. TI Type 502 ***Solid Circuit*** networks are available now for your evaluation. *TI engineers are ready now to design **Solid Circuit** networks to meet your missile, satellite, space vehicle, or other micro-electronic specifications.*

Contact your nearest TI Sales Engineer today!

TEXAS INSTRUMENTS INCORPORATED

*Trademark of TEXAS INSTRUMENTS INCORPORATED

SEMICONDUCTOR-COMPONENTS DIVISION

POST OFFICE BOX 312 • DALLAS, TEXAS

bidding estimated costs to get into the field, Air Force awarded it the contract.

During the past year, approximately 25% of the Aeronautical Systems Center's procurements, in terms of dollars, have included the AGREE reliability test provisions. Aeronautical Systems Center and other military groups will be watching carefully the results of initial field tests on the ARN-21C to determine what the additional reliability effort buys in actual improvement in return for the extra cost.

Not all military users are willing to pay the extra costs involved in the AGREE tests. For example, in a recent procurement of AN/ARC-58 single sideband equipments for the Strategic Air Command, Collins Radio told the Air Force it would have to increase its price by nearly 60% if the AGREE tests were included. Because initial models of the ARC-58 in service already were exhibiting satisfactory reliability, SAC was not willing to pay the premium and so the sets are not being procured to the AGREE specifications.

(One Air Force procurement official speculates that the premium quoted by Collins might have been less if the company had not been the sole source for the AC-58 and/or if the company had had previous experience with the AGREE tests.)

Test Levels

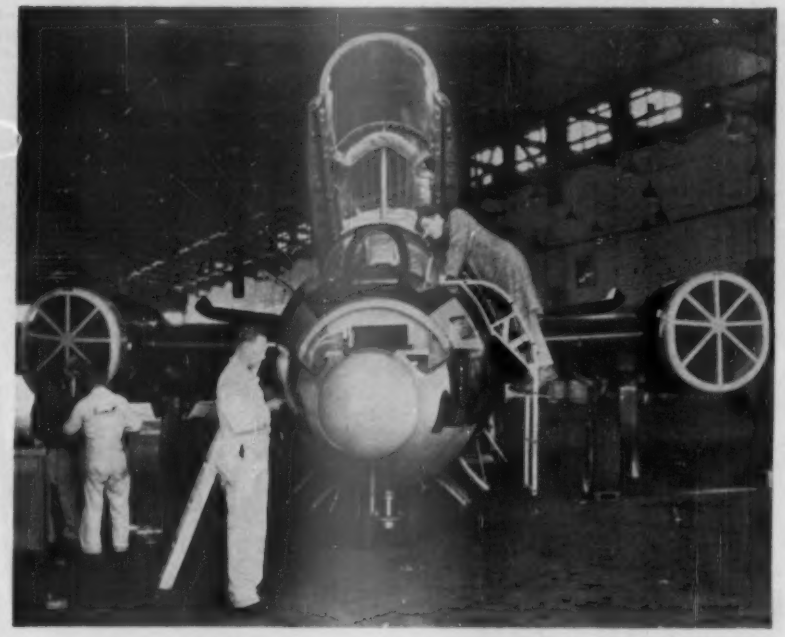
There are four different levels of environmental severity for the AGREE tests, depending upon the intended use of the equipment:

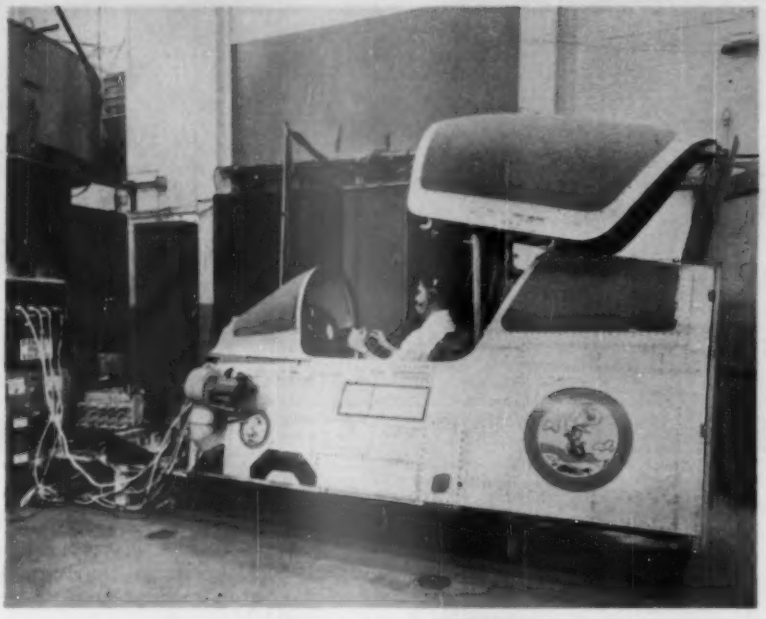
• **Light (L) Level:** Equipment is operated at 86F ambient temperature for three hours plus time required for equipment temperature to stabilize, then power is turned off and ambient temperature is dropped to 68F for same period of time, then temperature is raised again to 86F. Cycle continues for at least three times the length of the required mean-time-between-failure period specified for the equipment. Thus, for a 150-hr. MTBF requirement, equipment must be cycled until it has operated with power on for at least 450 hr., or nearly three weeks. There is no vibration involved in the Light Level and input voltage is the nominal value. This L-Level test is employed for ground-based equipment which operates in controlled environment.

• **Medium (M) Level:** Equipment must operate through a similar on-off cycle, except that ambient temperature during power-on condition is 113F and equipment is cooled to 95F during power-off portion of cycle. In addition, equipment is subjected to vibration of 25 cps., plus or minus $\frac{1}{32}$ in. amplitude without shock-vibration mounts for 10 min. out of each hour of operation. Input voltage is 98% to 100% of maximum specified for equipment. This M-Level test normally is required for shipboard equipment.

• **High (H) Level:** Equipment operates through similar on-off cycle, but power-on ambient temperature is 130F, followed by equipment cooling to −65F. Vibration and input voltage are same as for M-Level tests. The H-Level normally is used for airborne avionic equipment, such as Tacan.

• **Extreme (X) Level:** Similar to H-Level test, except that equipment





Terrain Avoidance System Tested

Flight tests of an experimental terrain avoidance system, developed by Cornell Aeronautical Laboratory under a Wright Air Development Division, ARDC, contract will begin soon. The program designated Project Autoflite, is an outgrowth of previous CAL work in this area. Terrain avoidance system and its special radar are being installed in a USAF-Martin B-57B for the flight tests. The current contract also covers development of an analog-type simulator which can test the ability of human pilots and the automatic terrain avoidance system to circumvent obstacles during low-level flight. The simulator, which uses an F-84 cockpit, can be adapted to test a pilot's reactions by using many types of radar terrain information displays. System was under development by CAL for the past three years.

Effective deployment of tactical missiles and their supporting troops and equipment calls, today, for full *off-road mobility*. In this concept, FMC offers long and versatile experience, having since 1941 designed and built more types of military-standardized tracked vehicles than any other company in America.

In recent years FMC has pioneered many developments in missile launchers, and in light-weight aluminum-armored vehicles that can be airborne and parachute-dropped, ready for extended cross country operations. We provide full mobility for missile transporters and launchers, GSE, radar and communications equipment, field hospitals, troop transport and other equipment. The use of standard military components in vehicles cuts R&D costs and eases logistics problems in the field.

When the question is mobility, FMC has the answer—from original concept through production delivery.

TO YOUR GSE MOBILITY NEEDS

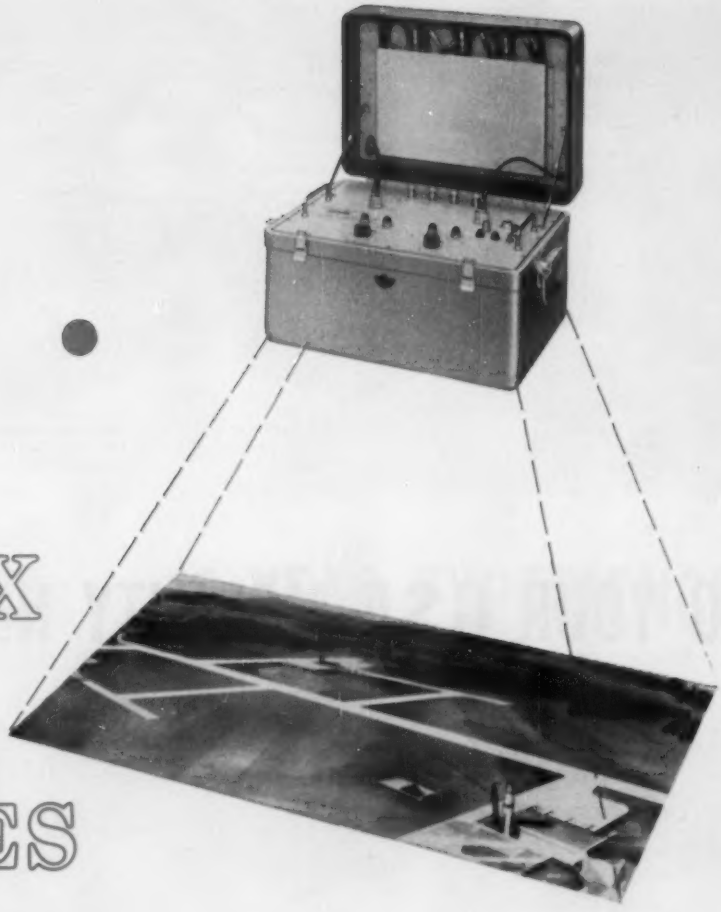
For further information, write, wire, or phone
Preliminary Design Engineering Dept., FMC Ordnance Division,
P. O. Box 367, San Jose, California • Phone: CYpress 4-8124

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
Ordnance Division
1105 COLEMAN AVENUE, SAN JOSE, CALIFORNIA

the new Giannini Portable Pressure Generator



A 2 FT. BOX THAT COVERS 10 ACRES

From 10 acres of launching area to a laboratory bench... in Ground Support, production or research ...now you can find a compact, portable Giannini Pressure Generator to do any of these things:

- Obtain precise static and pitot pressure readings from two related electromechanical pneumatic systems.

  Inspect, production-test and calibrate such systems. Test them on the flight line. Furnish arbitrary pressure outputs as a function of voltage inputs (manually or remotely selected) for simulated flight of missiles, aircraft and other vehicles.

- Generate absolute, differential or gage pressures and pressure ratios. Direct digital readout. Select from a variety of accuracies, resolutions, pressure ranges, ratios, rates.

Designed for maximum utility, Giannini's new pressure generators are easily transported. Rugged mechanically. Simple electronically. Give long, trouble-free life in lab or field.

Proof of performance: this useful new Ground Support unit is currently being used to test the Giannini Variable Inlet Control System on a new supersonic jet interceptor.

WRITE FOR DETAILS OR FOR A DISCUSSION ON YOUR SPECIAL APPLICATION NEEDS.

Specifications, Giannini Portable Pressure Generator

OPERATING MEDIUM
Dry (instrument) air

OPERATING INPUTS REQ'D.
Air Pressure: 20 to 30 PSIG
Vacuum Source: 0 to 2.0 inches of mercury (absolute)

OUTPUT PRESSURE RANGES
Static Pressure (P_s): 2 to 70 inches of mercury (absolute)
Pitot Pressure (P_t): Automatically determined by P_s and P_t/P_s settings
P_t/P_s Ratio Range: 0.580 to 0.940
Other Static and Ratio ranges available.
Differential Pressure Range: 0 to 30 inches of mercury.

POWER REQUIREMENTS
110 volts, 400 CPS—275 watts

OVERALL DIMEN. (Approx.)
Height: 14.5 inches
Width: 24 inches
Depth: 16 inches

AMBIENT TEMPERATURE
Range: −54°C (−65°F) to +55°C (+130°F)
Weight: Approx. 80 pounds

GCC 0-3

Giannini Controls Corporation 1600 South Mountain, Duarte, California

A NAME TO PLAN WITH

A challenging new career awaits you at Giannini: Write to the Director of Technical Personnel

must operate in ambient temperature of 160F, then be cooled to −85F. This level normally is used for airborne avionic equipment which must operate in extremely rugged environments.

During pilot production run on the ARN-21C program, Hoffman was required to pick seven sets from initial production and subject them to a 5-hr. power-on operation, with 10 min. of vibration each hour, at a 130F ambient temperature. Sets were then cooled to −65F for about 5 hr., then returned to 130F and the cycle repeated for 450 hr., or until sufficient failures occurred to justify halting the whole test. If a set fails during test, it is taken off, repaired and returned without interrupting tests on other equipments.

During these initial tests a year ago, the seven equipments experienced a total of 144 failures, giving an average mean-time-between-failure of only 17½ hr.—a long way from the 150-hr. MTBF required in the company's contract.

Every failure was carefully analyzed by Hoffman engineers to determine its basic cause. Within the restraints imposed by the requirement that the ARN-21C be interchangeable with earlier models, the company set about introducing reliability improvements. These included such things as installing a larger capacity cooling fan, redesigning the power supply to give regulated tube heater voltage, changing to improved quality components and modifying certain circuits.

Failures Cut

Another seven sets of the modified design were then placed on test. After each had operated for 450 hr., Hoffman found that the number of failures had been cut by more than half, to 59, but the average MTBF was only 54 hr., still far short of the goal.

Again each failure was carefully studied. The analysis showed, for example, that in the modified design there were more capacitor failures than in previous design, but the bulk of these were in a set whose cooling fan motor had failed. Fixed resistor failures were concentrated in the power supply module. Analysis of the circuits in this module showed that resistors were being operated beyond reasonable limits. Analysis showed, however, that the modification had greatly reduced the number of tube failures.

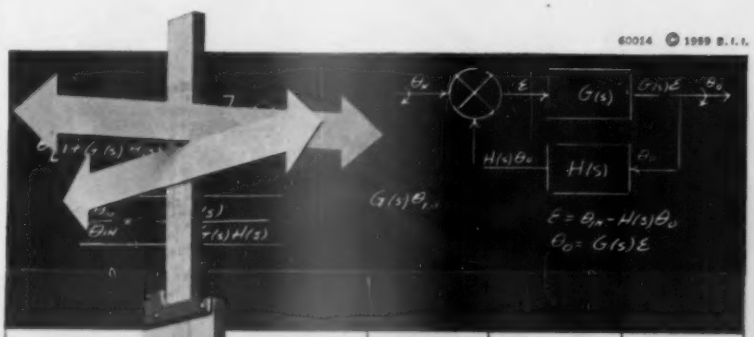
After another design modification and reliability improvement effort, Hoffman reached a MTBF of better than 75 hr. this spring. Air Force decided that it would be foolish not to release these sets for field use, inasmuch as they were far superior to those in use. However, Hoffman is required to continue to push up the ARN-21C mean-time-between-failure, with a figure of

sophisticated servo solutions

size 8's that do the work of 10's... 15's with 100,000 rad/sec² acceleration... 11's and 18's with inertia or adjustable velocity damping. Extract your solution from an infinitude of BECKMAN servomotors.

To satisfy the unknowns in your system, try these representative specs on your slipstick.

60014 © 1959 B.I.I.



	Size 8 servomotor-rate generator Model 8MG420/410	Size 11 velocity-damp servomotor Model 11VM460	Size 15 servomotor Model 15SM461	Size 18 inertia-damp servomotor Model 18IM460
Excitation	26v 400-cycle	115v 400-cycle	115v 400-cycle	115v 400-cycle
Length, inches	1.350	2.033	1.375	2.525
No-load, rpm	6,000	5,300	6,000	4,700
Torque at stall, oz. in.	0.22	0.63	1.45	2.35
Acceleration at stall, rad/sec²	68,000	22,200	100,000	22,200
Output voltage volts/1,000 rpm	0.1	—	—	—
Null voltage, millivolts	4	—	—	—
Additional damping available dyne cm. sec. / radian	—	10-100 (adjustable)	—	940

There are 10^{20} standard & spec types available in these popular sizes!

For complete crib-sheets... specs, drawings, torque speed curves and unit characteristics... write for data file K 253.

Beckman® / Helipot

Helipot Division of Beckman Instruments, Inc.
Fullerton, California
Engineering representatives in 29 cities

potentiometers: dials: delay lines: expanded scale meters: servomotors: breadboard parts

Now, all-weather power in a new Crusader!

The new F8U-2N *Crusader* shows how "growth potential" in fighter design makes sense. This all-weather fighter developed fast. Its basic engineering had been established and refined by the 500-plus *Crusaders* already with the Fleet. Their reliability and availability — proved by 250,000 hours of flight time and 25,000 catapult shots — accrued to the F8U-2N. And with this fighter, the flexible *Crusader* design once again "grew" to incorporate an advanced engine, improved accessory systems . . . new all-weather power for the Fleet. *The F8U-2N is a product of Chance Vought's Aeronautics Division, developers of missiles, aircraft, ASW equipment and other products for atmospheric defense.*

CHANCE VOUGHT AERONAUTICS DIVISION DALLAS, TEXAS

150 hr. being the goal after company has produced 1,000 sets.

Navy Bureau of Weapons has not yet applied the AGREE test provisions to any airborne avionics equipment procurement, a spokesman says, but it may do so in a forthcoming procurement of the new miniaturized AN/ARN-52 Tacan sets.

A spokesman says the Bureau heartily endorses the principle and probably would have put the AGREE tests to use earlier if it were not so squeezed for funds. He adds that the Bureau will closely monitor the field tests of the ARN-21C.

FILTER CENTER

▶ **Satellite Satellites**—In-house development program to demonstrate the feasibility of low mass and low physical density avionic systems which can be mounted on a pillow-shaped balloon carried below super-pressure balloons designed to gather meteorological data in the stratosphere and the troposphere as part of the proposed GHOST (Global Horizontal Sounding Technique) System is getting under way at Tele-Dynamics Division of American Bosch Arma Corp. Neither super-pressure balloons nor avionic gear are expected to constitute a hazard to air travel as they will harmlessly be destroyed if struck by a plane. Avionic gear will be mounted on 6-in.-square plastic MISTmodules (Minimum Structure) each of which contains one or more complete evaporated film circuits. Modules will then be pasted onto a 5-ft.-long, 18-20-in-wide Mylar strip, two of which may be sealed back-to-back to form a pillow which is valve-inflated before takeoff. Excess gas can be exhausted during ascent through an overpressure valve. MISTmodules will house complete systems, including transmitter, receiver, logical elements, all possibly powered by silicon solar cells evaporated on film and weighing about one pound. Balloons can be sent aloft for three to six months.

▶ **Autonetics Picks Suppliers**—Nine avionics companies are winning awards from North American Autonetics Division to supply components for firm's avionics reliability program (AW Oct. 19, p. 69), aimed at boosting reliability level by a factor of 100. Companies with contracts in hand are Motorola $1.72 million, for mesa transistors; Fairchild Semiconductor, $1.5 million for silicon transistors; Pacific Semiconductor, $1.3 million for transistors and diodes; Transitron, over $1 million for transistors and diodes. Five more $1 to $2 million awards are to be signed with other companies within two weeks.

How Quaker Thermoid made ground-refueling hose to meet toughest government specifications

1. Developed a tube compound that can carry all aircraft fuels without showing appreciable signs of swelling or loss of adhesion to the carcass. A tube that withstands constant bending, twisting, and flexing without ply separation. Performs well in the range −40°F to +130°F.

2. Developed a tube reinforcement that is lightweight for easy handling and storage, yet able to withstand extremely high pressure without bursting. Resists weather, mildew, rot, and oil.

3. Developed an abrasion- and oil-resistant cover compound that protects the tube and reinforcement from damage when the hose is dragged over concrete aprons.

4. Completely bonded all component parts by an exclusive process of curing and manufacturing to provide a ground-refueling hose that is not only strong and easy to handle, but the safest ever built.

Get complete information on Thermoid-Quaker ground-refueling hose from your local Thermoid industrial distributor, or write *Thermoid Division, H. K. Porter Company, Inc., Tacony & Comly Sts., Philadelphia 24, Pa.*

THERMOID PORTER DIVISION

H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

Ryan research finds new ways to get off the ground

Ryan is the pioneer and leader in vertical jet flight—the shortest and quickest way into the sky—with more than three million man-hours of research, design, and engineering experience with VTOL aircraft.

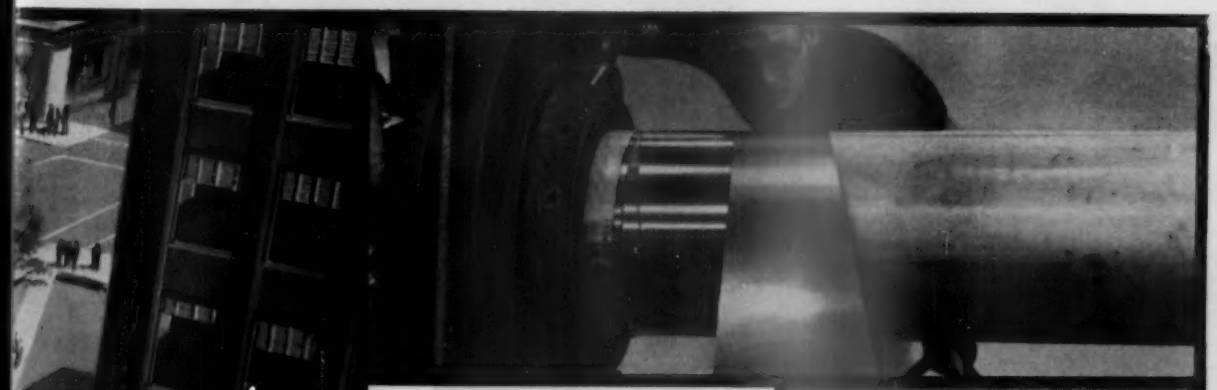
The world's first pure jet VTOL aircraft, the Ryan X-13 Vertijet, set a milestone in flight technology when it made its spectacular demonstration flights at Edwards AFB, and Washington, D. C. It was designed, developed, and built by Ryan four years ago for the United States Air Force.

Advanced knowledge has also been gained in the VTOL/STOL field with the Army VZ3RY aircraft, a turboprop-driven research plane which Ryan designed and now has under test for the Army and the Office of Naval Research. It employs the deflected slipstream principle.

Now Ryan is underway on a new Air Force study contract for an even more advanced VTOL concept. It is the Vertifan which provides, in a single propulsion system, thrust for both vertical and high-performance horizontal flight.

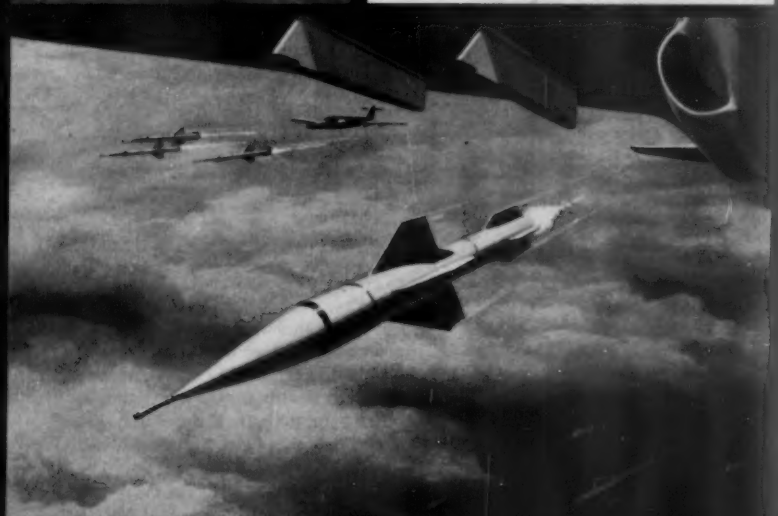
In the electronics field, Ryan is a recognized world leader in continuous wave doppler navigation systems. Ryan developed the first successful C-W doppler navigator—the most effective new method of aerial navigation for both high and low speed flight. Today Ryan navigators guide all types of aircraft, from helicopters and slow flying reconnaisance aircraft to high altitude supersonic jets.

Ryan's bold research plans in VTOL aircraft and navigation systems have blazed a trail toward a new generation of military and commercial aircraft with increased capabilities.



RESEARCH AT RYAN has produced a unique, new "strip-winding" technique for making lightweight cylinders of very high strength. Ryan now uses this process, called Ryan Wrap, to build rocket chambers for the Navy's submarine-launched Polaris missile. Thin strips of steel are wound around a mandrel and electrically welded into solid form.

RYAN BLASTS tough space-age metals into complex shapes with high explosives. With a few cents worth of explosives, Ryan achieves forming pressures of over one million psi, to form tough alloys with precision, which could not be formed by any other methods. This has given Ryan a unique, new capability in meeting difficult fabrication problems.



THE SPECIAL SKILLS, advanced scientific know-how, and integrated facilities needed to build many types of missiles and rockets, or their components, are under one roof at Ryan. Ryan's missile capabilities stem from the fabrication of missile propulsion systems; the development of advanced navigation and guidance systems based on continuous wave doppler radar; and the design and production of over 1300 Firebee target missiles – America's most widely used jet target.

Ryan offers challenging opportunities to engineers

RYAN BUILDS BETTER

AIRCRAFT • MISSILES & COMPONENTS • ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.

NEW MICROFILM PRINTER DOES WORK OF 25 MEN AT 1/2 THE COST!

TWENTY FIVE MEN plotting graphs at top speed could not keep up with Stromberg-Carlson's S-C 4020 High Speed Microfilm Printer. In a typical graph plotting application, the S-C 4020 can do the job *better* – at ¼ to ⅓ the cost! And the S-C 4020 can save you money in dozens of other important applications. It will accept the output – on-line or off-line – of most major computers and produce accurate, high-quality recording on microfilm at rates of 15,000 plotting points or alphanumeric characters per second.

The S-C 4020 may be used for plotting graphs, drawing axes, drawing vectors or printing full pages of tabular data. Mathematical formulas used for design of mechanical components may be printed as drawings with significant dimensions superimposed on the design. Ship's hull equations, aircraft wing sections and other critical design components requiring descriptive geometry may be graphically displayed. With an optional automatic processing camera, graphs or tabular data may be viewed on a special screen only 8 seconds after film exposure.

LITERATURE AVAILABLE: Learn the complete story of the S-C 4020. Write to Dept. A-52, Stromberg-Carlson-San Diego, 1895 Hancock Street, San Diego, California.

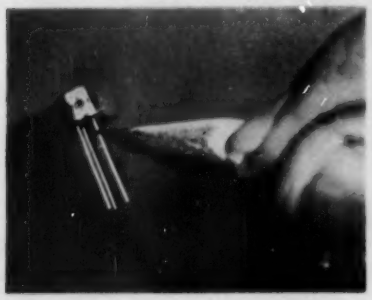
STROMBERG-CARLSON-SAN DIEGO

A DIVISION OF **GENERAL DYNAMICS CORPORATION**

NEW AVIONIC PRODUCTS

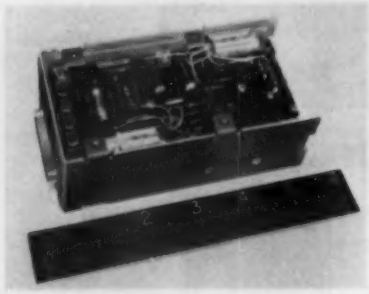
Components & Devices

• **Switching transistor,** Type 2N706A, an improved version of standard 2N706 silicon mesa transistor is available with guaranteed d.c. beta ranges of 20 to



60, 25 nanoseconds charge storage time constant, 5 to 6 picofarads output capacity, 40 nanoseconds maximum turn on time, 75 nanoseconds turn off time among other characteristics. Texas Instruments, Inc., P. O. Box 312, Dallas 21, Tex.

• **D.C. Amplifier,** Model 100A, designed to convert low level d.c. input to ±2.5 d.c. output. Features include continuously adjustable gain between steps of 10 to 100 and 100 to 150, 0.5% best straight line linearity, gain stability of 0.5% full scale of 25C



value, less than 5 kilohms output impedance, and 20 mv. peak to peak ripple (carrier). Intended for strain gage and thermocouple applications, units are available on sixty day delivery from Temco Aircraft Corp., P. O. Box 6191, Dallas 22, Tex.

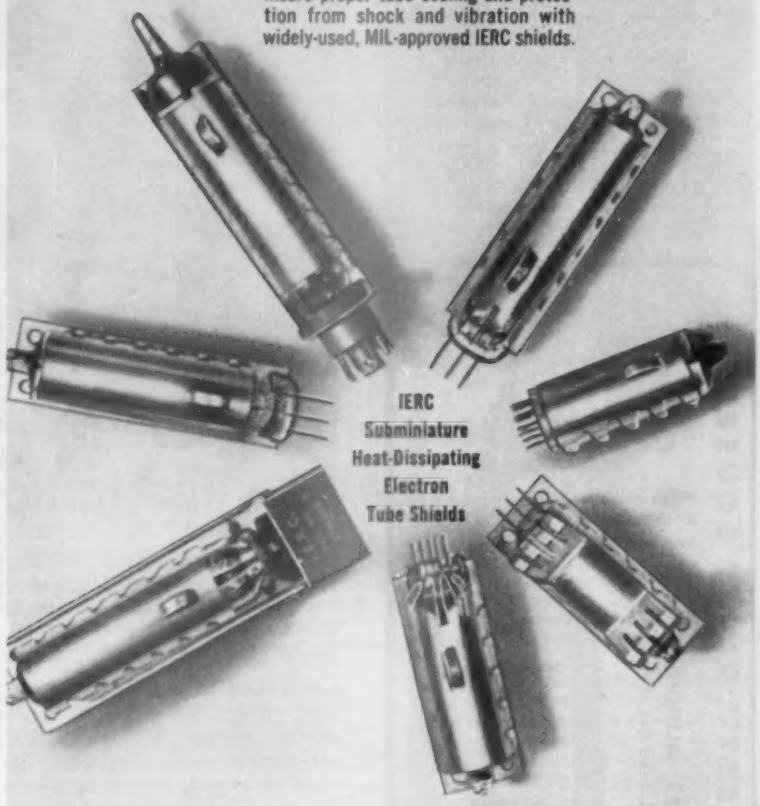
• **Silicon power rectifiers,** B2000 series, with piv of 2,200 v. and current ratings from 200 mils through 10 amps are available in hermetically sealed packages which will operate from −60C to 150C. Forward voltage drop does not exceed two volts. Britton Electronics Corp., 19 Warren Pl., Mt. Vernon, N. Y.

• **Voltage regulator,** designed for airborne telemetering transducer circuits,

FIRST THINGS FIRST!

FOR IMPROVED THERMAL DESIGN, there is no substitute for effectively cooling, extending useful life and increasing tube reliability than with IERC Heat-dissipating Electron Tube Shields.

The right time to "plan in" IERC's Heat-dissipating Electron Tube Shield components in your thermal design and packaging is at the start—however, it's never too late to improve reliability, insure proper tube cooling and protection from shock and vibration with widely-used, MIL-approved IERC shields.



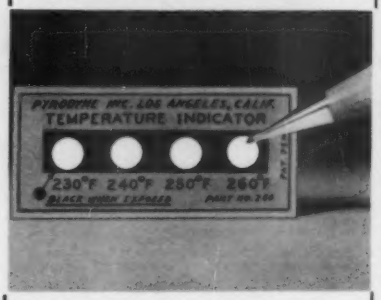
IERC Subminiature Heat-Dissipating Electron Tube Shields

New 1960 Subminiature Tube Shield Catalog gives you a complete showing of IERC's diversified line, thermal design and application tips, dimensional and specification data—available on request.

IERC DIVISION

INTERNATIONAL ELECTRONIC RESEARCH CORPORATION
135 West Magnolia Boulevard, Burbank, California

TEMPERATURE INDICATING LABEL



100°F through 1100°F

Backed with pressure-sensitive adhesive, TEMP-PLATE indicators turn black to record temperatures of mounting surface. Impervious to broad environmental exposures. TEMP-PLATES detect hot spots and overheating on wheels, wings, brakes, nozzles, skin surfaces, electronic and mechanical equipment of all types. Four models available in one, four, six, and eight increments. *Write for brochure and price list.*

PYRODYNE, INC.
11973 San Vicente Boulevard
Los Angeles 49, California

"REDI-SET" RIVET SQUEEZERS

WITH ADJUSTABLE & INTERCHANGEABLE DIES

CAPACITY 5/32" ALUMINUM RIVET
Develops 3,500 lbs. Pressure

DIES:
COUNTERSUNK
FLUSH
FLAT
ROUND
BRAZIER
MODIFIED
BRAZIER
HEADS
OR FOR COUNTERSINKING

Write for BIG NEW CATALOG

WHITNEY METAL TOOL CO.
734 Forbes St., Rockford, Ill. Since 1910

which employs solid-state components and holds outputs between 4.975 and 5,000 volts over −65 to 185F range is available. Specs call for 22 to 29 v. d.c. input. Unit weighs 5 oz., measures 1.5 in. x 1.5 in. x 1.5 in. Vap-Air Division, Vapor Heating Corp, 6420 West Howard St., Chicago 48, Ill.

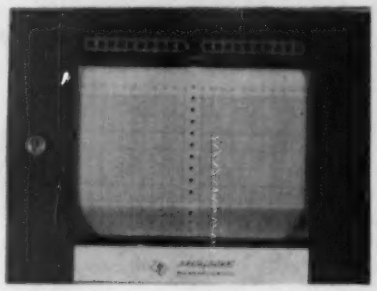
• **Gyros,** Models Q2315 (free gyro), B2115 (vertical gyro), A2215 (directional gyro), designed to meet thermal, shock, sand and dust, salt spray, humidity, and fungus conditions specified in MIL-E-5272C, can be obtained. Gyros weigh 5.5 lb. maximum, have inner and outer gimbal inertia of 1,050 and 5,900 gm.-cm. squared, respectively, can operate from −54C to 71C and can withstand 60g shock. Kearfott Division of General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

Instruments

• **Bridge, Model 544-B,** can measure deviations as small as one part in 10,000 in resistors, inductors and capacitors. Bridge incorporates meter relay with both high and low contact settings and is suitable for go-no go production checks. This model is available in either

relay rack or portable styles. Ranges which can be measured are: 3 ohms to 5 megohms; 500 picofarads to 1,000 microfarads; 3 millihenries to 10,000 henries. Metronix, Inc., Chesterland.

• **Recording systems,** Models BSA-250 (ink writing) and BSA-260 (ink and electric writing) 40 mm. amplitude two-channel portable rectilinear recording systems with interchangeable plug-in preamplifiers. Basic assembly includes carrying case with blower and swing-up carrying handle, chart drive with 0.5, 2, 5, 20, 50 and 200 mm./sec. speeds, two oscillograph units—one with manual 60 cycle signal event marker—and two transistorized compensated drive amplifiers. System requires 105 to 125 v. 60 cps., 60 watts. Maximum undistorted amplitude full scale is 40 min., d.c. to 40 cps.; half scale d.c. to 80 cps.; quarter scale d.c. to 120 cps. Massa Division of Cohu Electronics, Inc., 5 Fottler Rd., Hingham, Mass.

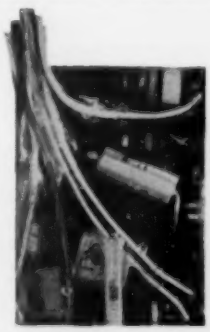


• **Strip-chart recorders,** flush mounting models of firm's galvanometric recorders for panel installations are available. Both single and dual channel models with swing out chart carriages and slide out chassis for accessibility can be obtained. Illuminated scales for better visibility from a distance are included. Texas Instruments, Inc., 3609 Buffalo Speedway, Houston 6, Tex.

Radio Equipment

• **Transmitter,** Model 99SSB, designed primarily for point-to-point ground-to-air communications on frequencies from 2 to 32 mc. in USB, LSB, double sideband, independent sideband, compatible SSB and SSB radioteletype are being offered. Up to four easily removable SSB heads of type shown, each incorporating its own exciter, can be inserted into 33 in. x 72 in. x 30 in. transmitter cabinet. Wilcox Electric Co., Fourteenth & Chestnut, Kansas City 27, Mo.

New Kinetics switch transfers battery power automatically in space craft



Part of the electronic circuitry that senses battery voltage and operates the switch to transfer the load to another power source when voltage drops to pre-set level.

For satellites, deep space probes or extended space flights, it is frequently necessary to switch from an exhausted battery to a fresh one or to solar power. Now Kinetics Corporation has combined an ultra reliable switch with a voltage-sensing element to meet this critical requirement. The new Kinetics switch is motor driven. It is more rugged and reliable than other designs and is impervious to shock and vibration.

The switch exhibits no contact chatter over the whole vibration spectrum, from 5 to 2000 cycles, 40 G's. Voltage drop across typical switch contacts is less than 10 millivolts at 22 amps. No power is required to hold the switch open or closed. High density construction permits as many as 21 circuits in less than 14 cubic inches.

An ultra-sensitive electronic circuit measures battery voltage. When the sensed voltage falls to a pre-set level, the circuitry passes current to the switch motor, causing power transfer. It may be applied in systems where a missile is switched to internal battery power after check out on ground power. After launch, when the missile is in flight and the first battery is discharged, the same switch can transfer the load to a fresh battery or to solar cell power. For systems employing more than two batteries, additional switches can be utilized for programed or automatic power change overs.

For any switch application where absolute dependability under tough environmental conditions is essential, write or phone Kinetics Corporation, Dept. K-26, 410 S. Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

KINETICS CORPORATION

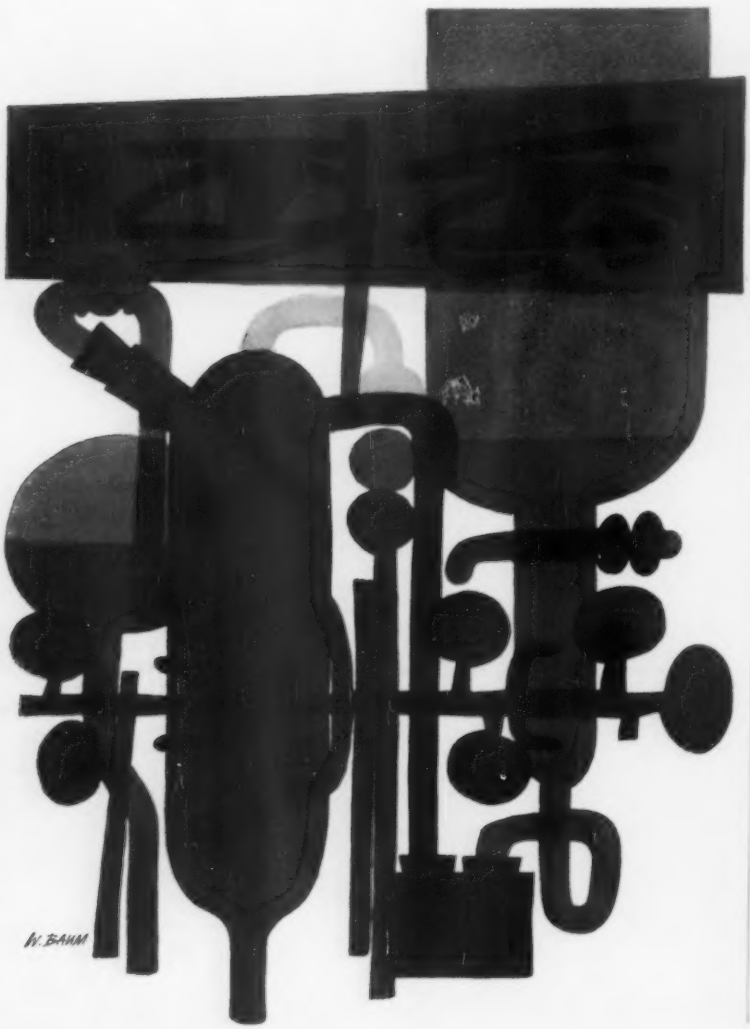
ELECTRONICS · ELECTROMECHANICS

FORECAST

Laboratories for space science at Martin are now studying and forecasting the physical, psychological, and biological factors that will affect man in space...another tremendously fascinating program which attracts persons with exceptional professional abilities. If you have these abilities, you are invited to communicate with N. M. Pagan, (Dept. CC-11) The Martin Company, P. O. Box 179, Denver 1, Colorado.

MARTIN

DENVER



ON OUR STAFF

If you need effective, highly readable, smartly illustrated company literature (booklets, pamphlets, manuals) to display your products, inform the public of your operations, attract key personnel to your plant, and perform any of the other communicative functions vital to your business, let TECHNICAL WRITING SERVICE do the job for you.

WRITING • EDITING

ILLUSTRATING

PRINTING

We produce your publications, to your specifications. We give complete service—from research and planning through writing, design, and printing. Let our staff be your staff. It will save you time and money.

— We Prepare —

EQUIPMENT MANUALS HANDBOOKS • PRODUCT BULLETINS • TRAINING AIDS PAMPHLETS • REPORTS BROCHURES • COMPANY HISTORIES • PARTS LISTS and other such special material.

Write • Phone

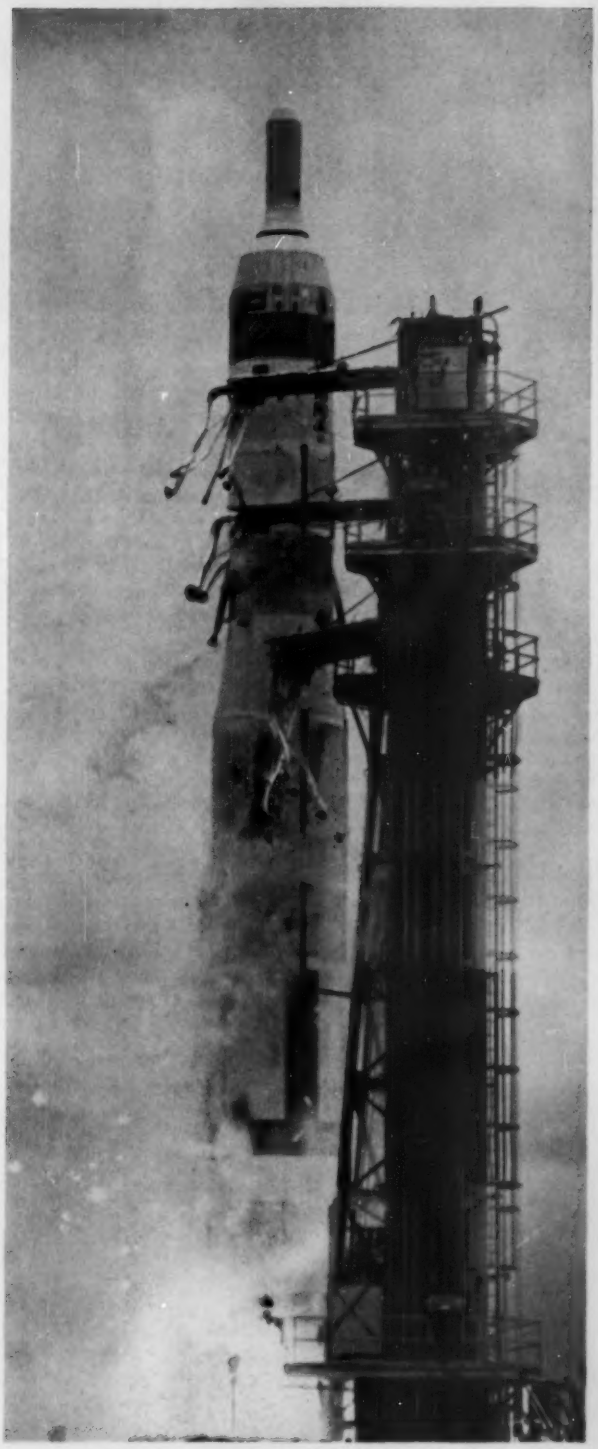
TECHNICAL WRITING SERVICE

McGraw-Hill Book Co., Inc.

330 W. 42nd St., N. Y. 36, N. Y.

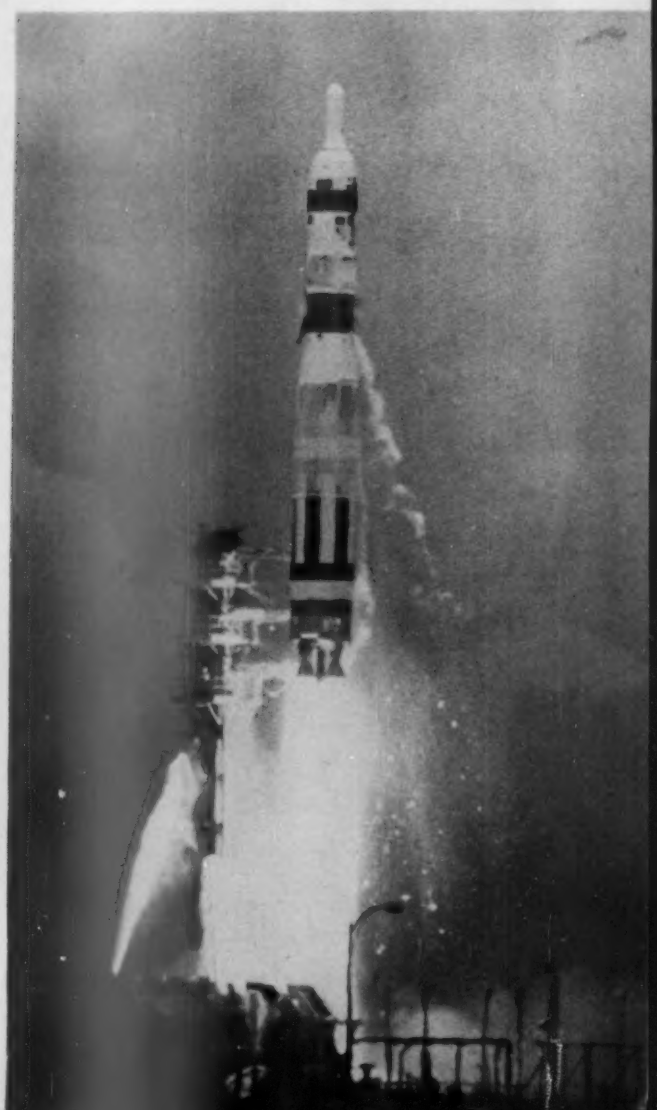
LOngacre 4-3000

Titan G Fired Full Range



Avco Mk. IV nose cone was carried on the shot. The re-entry body, which has a triconic flare section discernible above black horizontal stripe, is similar in configuration to the RVX-3 and -4 series. Shot was the fifth to go full range and sixth success in a row. Vehicle was one of the G series and will be followed by the J series operational prototype.

First SAC officer to act as test conductor on a Martin Titan intercontinental ballistic missile firing, Capt. Albert B. Whittemore sits at console. Shot was to serve as a Midas test but the infrared detection satellite malfunctioned.



Sikorsky S-55 approaches parachute with hook steadied by wooden boom. At right, pilot flies boom into falling chute.

Helicopter Demonstrates Chute Recovery

Georgetown, Del.—Aerial recovery of parachuted objects by means of helicopters is proposed for the recovery of target drones and guided surveillance missiles. The feasibility of the recovery system was demonstrated here to Army, Navy, Air Force and Marine Corps representatives.

All American Engineering Co., Wilmington, Del., developed the helicopter recovery method with the cooperation of the Sikorsky Aircraft Division of United Aircraft Corp. The Delaware company developed the re-entry vehicle recovery system using Fairchild C-119s. This system has yet to be tested under actual conditions due to failure to drop a signaling Discoverer vehicle within the prescribed re-entry area.

The test drops were made from a Piper Tri-Pacer flying at 7,500 ft. Average descents of 1,500 fpm. were achieved with a 24 ft. parachute reefed to a diameter of 18 ft. The helicopter, a Sikorsky S-55 fitted with a grappling hook, approached the descending chute from about two miles out; contact is made at approximately 70 kt. The hook is fitted to the end of a wooden boom for stabilization until it snags the chute, at which point it is released, to trail the chute behind the helicopter. Engagement shock is reduced by an All American-designed energy absorbing winch.

During the four successful recoveries made by the helicopter, engagements were never made on the first attempt. The helicopter's maneuverability, however, made second, third or more passes possible before the chute struck the ground. After the parachute was snagged, the trailing package was easily brought to ground level where it was disengaged by ground personnel.

Maximum weights recoverable with Sikorsky helicopters include: S-58—3,600 lb., S-56—6,000 lb., HSS-2—7,000 lb., according to the manufacturer. Sikorsky says that its S-64 turbine crane helicopter will be capable of recovering loads to 15,000 lb.

Upon snagging parachute (note downwash effect, above left), cable is released from boom and chute is trailed to recovery area.

Altimeter System Corrects Pitot Error

By William S. Reed

Los Angeles, Calif.—Fail-safe, static-pressure compensating system operating in conjunction with standard, non-servoed altimeters, has been developed to eliminate altimeter errors due to pitot static position error.

Produced by the Garrett Corp's AiResearch Manufacturing Division, the system corrects error in the measurement of true altitude pressure caused by installation errors of static pressure sensors or by variations in measurement of static pressure from changes in Mach number, angle of attack, or yaw.

Essentially, the system solves, in analog fashion, the relationship between indicated static pressure and true static pressure as determined in airspeed and altimeter calibrations during flight test. It is designed for use in both military and commercial-type aircraft and eliminates the use of static pressure error correction cards where installed.

Indicated static pressure (P_{si}) from the pitot static sensor is accepted by the pressure compensator which corrects this value to true static pressure (P_s) by compensating for position, Mach or angle of attack errors.

Resulting true static pressure output is an actual pneumatic pressure rather than an electrical representation of pressure.

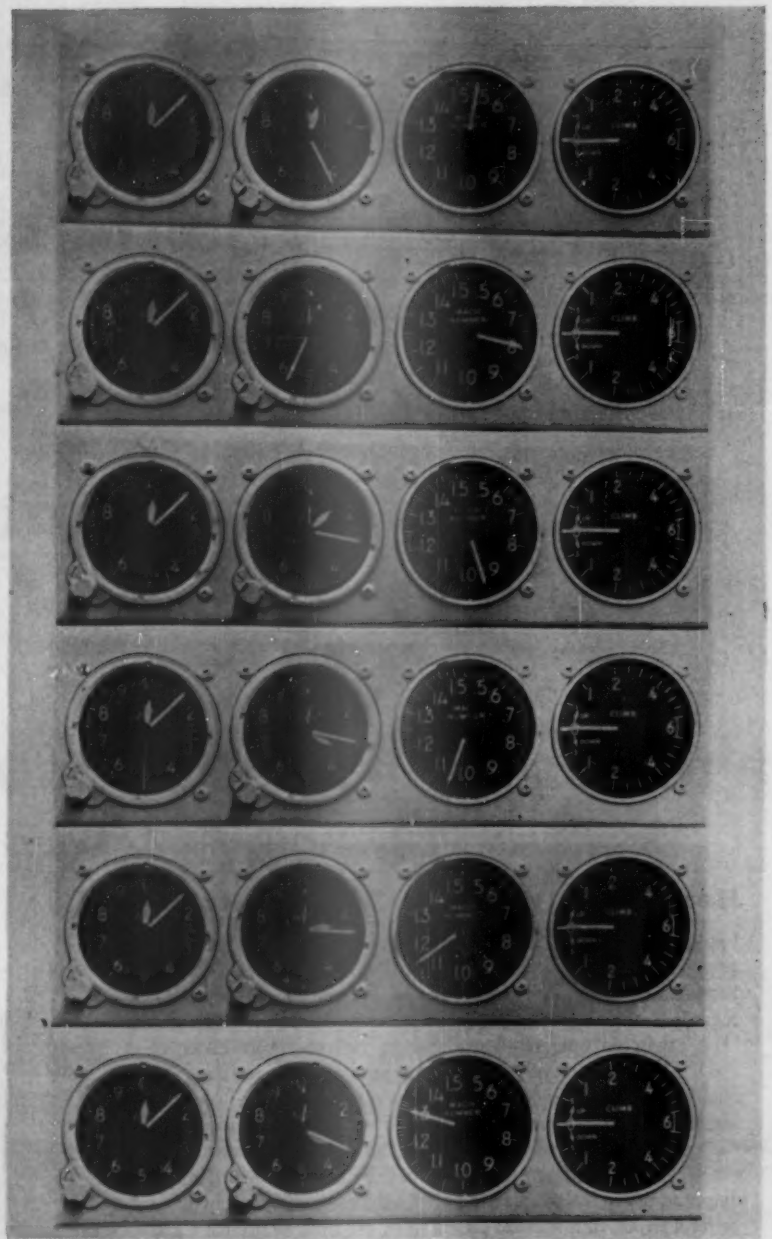
Inclusion of the static pressure compensator in the pitot static system provides corrected static pressure to be supplied directly to the cockpit instruments.

How It Works

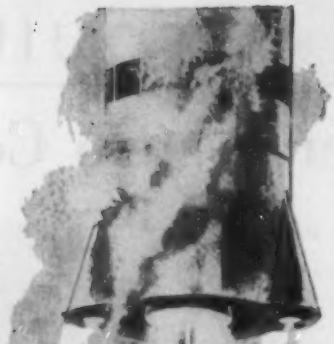
In operation, the static pressure compensator functions as a force balance transducer. Forces applied to the balance beam are proportioned to the indicated static pressure (P_{si}) and true static pressure (P_s). The Mach transducer schedules the position of the fulcrum for the beam balance and thus schedules the ratio of P_{si} (the input) to P_s (the output).

When a new fulcrum position is scheduled, the beam unbalance is sensed by a pneumatic valve which either adds or subtracts pressure to the output (P_s) until the beam is rebalanced. Engine bleed air is used as the positive pressure source. Negative pressure source is obtained through the use of a jet pump.

Multiple installation of instruments in the pitot static system is permissible



CHARACTERISTICS shown on test panel mockup are those inherent in a Century-series fighter aircraft. The Garrett Corp.'s AiResearch Manufacturing Division compensator cancels out the errors which are mainly caused by pitot static position error. The panel shows the relationship between true, stabilized altitude (column 1), indicated altitude (column 2) and Mach number (column 3). In the first row, a 300-ft. error is evident at a speed considerably below Mach 0.50. In the second row, the error is 450 ft. at Mach 0.79, jumping to 1,200 ft. at Mach 0.95. The error is greatest at Mach 1.05 due to Mach effects, but drops off at 1.15 and increases again at Mach 1.30. The AiResearch system is designed to be used in military and commercial aircraft and eliminates the need for static pressure error correction cards where installed.



Sealed and Shock-Resistant ...precision

Hermetically Sealed "HR" Switches

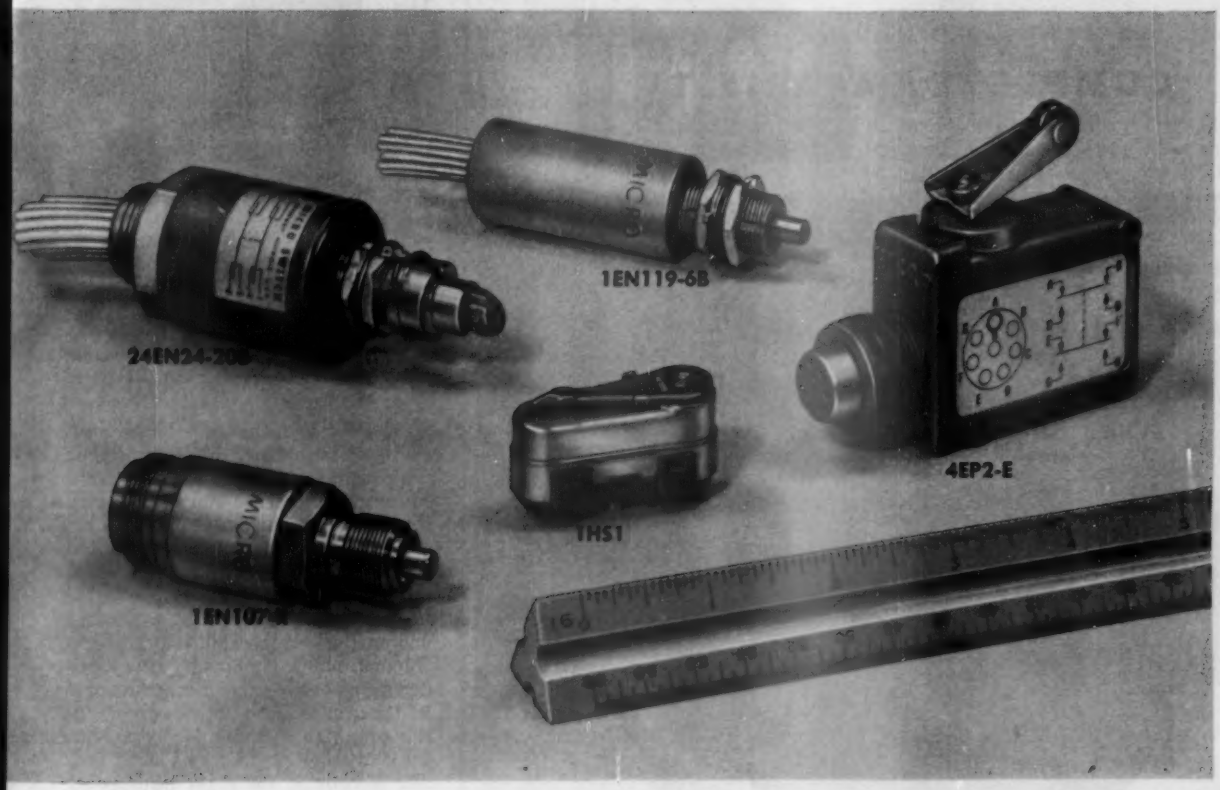
Explosive shock or high temperatures from missile exhausts present no problem to MICRO SWITCH "HR" switches. They are hermetically sealed to maintain constant operating characteristics regardless of changes in atmospheric or environmental conditions. "HR" switches operate dependably in a temperature range of −65° to +600°F. All exposed parts are corrosion resistant. To qualify as a true hermetically sealed switch, the chamber containing the switching element is evacuated and filled with inert gas; the conductor sealing is glass-to-metal and metal-to-metal, and the contained switching unit is actuated through a sealed metal diaphragm. An ice scraper ring on the actuator shaft removes ice or mud which might cause jamming or binding. Write for Catalog 77 which describes "HR" and other MICRO SWITCH enclosed switches for airborne equipment.

12HR1-S and **22HR1-S** — Both contain two single-pole double-throw snap-action switching units. 5 amp. (resistive), 28 vdc.

12HR8-6—Has high-temperature lead-wire extending from internally threaded conduit hub. 5 amp. (resistive), 28 vdc.

12HR1-S **22HR1-S** **12HR8-6**

MICRO SWITCH Precision Switches



switches for missile launchers

The most complete test laboratory in the precision switch industry makes it possible for MICRO SWITCH to test switches under severe conditions of shock, vibration, temperature or altitude. This has made possible a complete line for missile, aircraft, rocket, launcher, marine and ordnance applications. Here are just a few of the switches specially designed for missile launching:

1EN107-R Meets BUORD requirements, can withstand 1,000 pounds of sea water pressure per square inch. Has two high-shock basic switches. Write for Data Sheet 176.

4EP2-E Sturdy housing, exceeds shock and vibration resistance tests MIL-S-6743 and MIL-S-6744. Also meets immersion tests for MIL-E-5272A. Conduit hub houses sealed solder terminals and elastomer seal gland. Write for Catalog 77.

1HS1 Single-pole double-throw contact arrangement, conductors sealed in glass. Metal housing is evacuated and filled with dry inert gas under pressure, a true hermetic seal. Write for Catalog 78.

1EN119-6B and **24EN24-20B** Both are used on missile test stands. Environment-proof seals with ice scraper rings on actuator shafts to remove ice or mud which might cause jamming or binding. Write for Data Sheet 176.

A nearby MICRO SWITCH branch office puts capable switch experience close to you to save time. See the Yellow Pages for the telephone number.

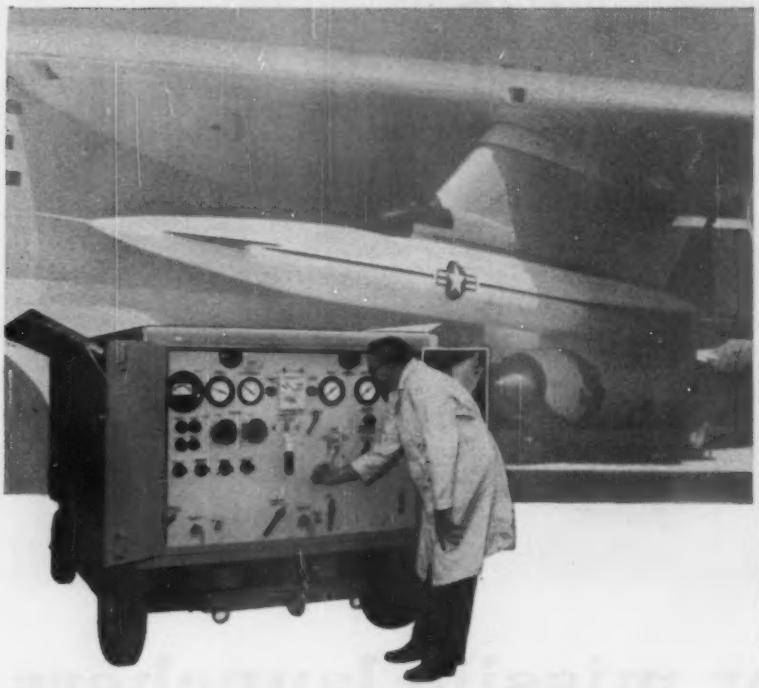
MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

75 YEARS HONEYWELL PIONEERING THE FUTURE

Honeywell
MICRO SWITCH Precision Switches

COMPLETE CAPABILITY

hma



GSE

Now in quantity production, Horkey-Moore-designed Ammonia Servicing Trailers will help SAC's Hound Dog equipped B-52Gs guard the peace of the '60s. Designed to a new modular concept, pioneered by Wright Air Development Center and North American Aviation, GAM-77 ground support equipment like this HMA trailer lowers costs and improves airborne readiness. Here's another instance where Horkey-Moore engineering ability and production experience have been called upon for advanced, reliable ground support systems for aircraft and missiles.

hma

horkey-moore associates

Division of Houston Fearless Corporation
24660 Crenshaw Boulevard
Torrance, California / SPruce 5-1211

STATIC PRESSURE compensating system consists mainly of a pressure ratio transducer and a static pressure compensator. AiResearch mockup equipment is shown.

because the compensator provides pneumatic pressure. Since the static pressure compensator presents a load of only ¼ cu. in. to the static line, static time constant is not impaired.

The static pressure compensator unit is equipped with fail-safe circuitry which allows indicated static pressure to be fed to flight instruments in the event of a malfunction. A cockpit warning light automatically is illuminated after a predetermined time delay if a malfunction in the compensator should occur. At the same time, a spring loaded fail-safe valve switches the indicated static pressure directly to the flight instruments.

The new system is similar to components already developed for AiResearch's central air data system aboard the North American A3J and the McDonnell F4H aircraft.

British to Gather Data On High Temperature Metals

London—National information center for the correlation and dissemination of data on creep and fatigue in high temperature metals is to be set up by the Department of Scientific and Industrial Research at the National Engineering Laboratory, East Kilbride, England.

All British metallurgical research organizations will submit to the center experimental data, which will be reduced and presented in an agreed form to users and designers. A much needed attempt will also be made by the center to coordinate British research work in these fields and to standardize test procedures used.

The bureau is part of an urgent DSIR program to expand current fatigue and creep research programs, including the erection now under way of a new creep testing laboratory at East Kilbride, where special techniques and equipment will be developed.

WHAT'S NEW

Publications Received:

Propulsion Systems for Space Flight—William R. Corliss—McGraw-Hill Book Co., 330 W. 42nd Street, New York, N. Y. $10.000; 350 pp. Such propulsion systems as the nuclear rocket, ion drives, photon drives and anti-gravity devices are discussed. A detailed description of the major propulsion concepts for flight beyond the atmosphere.

German Military Aircraft in World War II.—Eiichiro Sekigawa—Aero Publishers, Inc., 2162 Sunset Blvd., Los Angeles 26, Calif. Two boxed volumes at $6.95, 420 pp. Over 200 photos and three-view drawings, descriptions, specifications, performance data, engine and armament data, history, production information and information on the experimental planes are given. One volume of the two is printed in Japanese and it is this volume that contains the photos and drawings; the other is an English translation.

The Hero—Charles A. Lindbergh and the American Dream—Doubleday & Co., New York. $4.95. A biography of the life of Charles A. Lindbergh.

British Civil Aircraft 1919-59 Vol. I.—A. J. Jackson—Putnam, 42 Great Russell St., London WC 1. Approximately $8.82 (63 shillings) Reference work on all aircraft ever used for civil purposes under British ownership.

Avionics Research—E. V. D. Glazler, E. Rechtin and J. Voge. Pergamon Press, Inc., 122 E. 55th Street, New York 22, N. Y. $10.00; 265 pp. Reports presented by international experts at the Agard Avionics Panel Meeting held in Copenhagen contained herein. The theme is the detection and tracking of targets at high altitudes and extreme ranges.

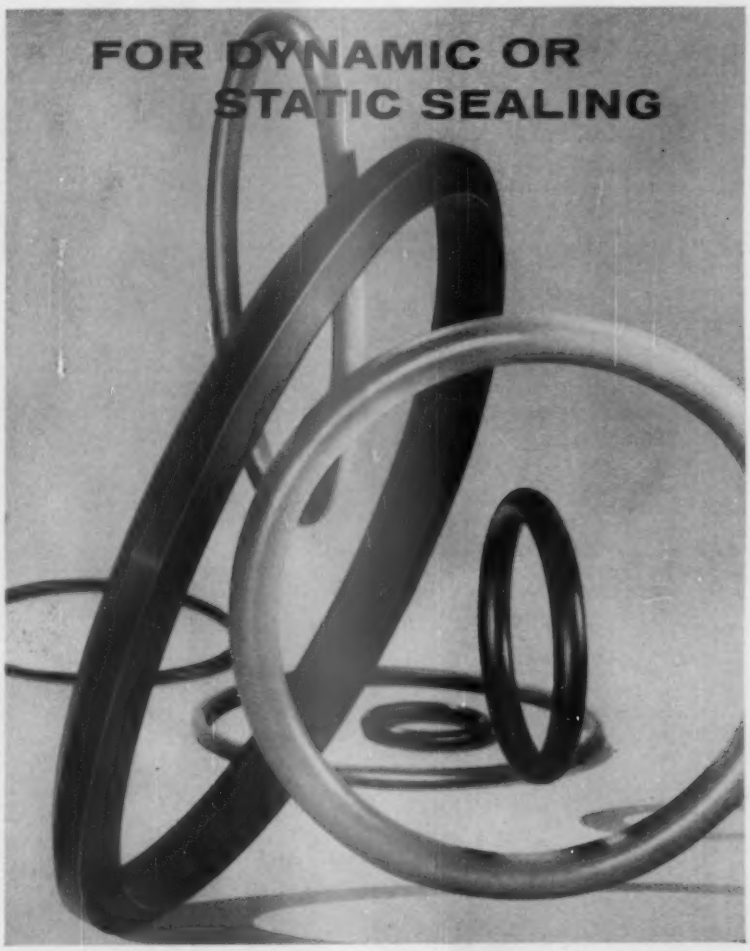
Radargrammetry—by Daniel Levine—McGraw-Hill Book Co., 330 W. 42nd Street, New York, N. Y. $12.00; 330 pp. Analyzes the sources of error found in the real radar display and outlines a unified system design for keeping individual errors within bounds to meet an over-all system performance.

Air Aces of the 1914-1918 War—Bruce Robertson—Aero Publishers, Inc., 2162 Sunset Blvd., Los Angeles 26, Calif. $8.50; 211 pp. 8¼ x 11. Compiled by eight aeronautical history authorities of the major countries engaged in World War I. It contains biographies of the aces of the U. S., Britain, Italy, Belgium France, Germany, Russia, and Austria-Hungary. With 350 photos of them and the aircraft in which they fought. An appendix contains the ace's scores, tables of fighter aircraft production data, identification markings and a list of the airmen who received their country's highest awards.

Photomicrography of Metals—Sales Service Division, Eastman Kodak Co., Rochester 4, N. Y. $.50 & .10 for handling; 44 pp. Illustrated with photos, charts and graphs, containing six major sections on the metallographic microscope, illumination, filters in metallography, exposure determination, processing and printing.

Man High—Lt. Col. David G. Simons (MC) USAF with Don A. Schanche—Doubleday and Co., Garden City, N. Y. $4.50; 262 pp. An account of a balloon ascent that was to carry the first human into the threshold of outer space, of the 32 hr. spent there and the final outcome of this experiment.

Russian Aircraft—Ian Allan Organization Co., Ltd., Craven House, Hampton Court, Surrey, England. Approximately $.35 (2/6), paperbound, 32 pp. This book by John W. R. Taylor contains photographs and data on Soviet aircraft. Included are the records standing at the time the book closed for press.



Meeting the most critical specifications of the military and of industry, Stillman O-Rings, Seals and Gaskets are fast becoming the standards of sealing for specialized requirements. Stillman laboratories are developing new compounds and new production techniques which furnish the customer with vital sealing so necessary in our present stepped-up programs for space exploration and missile development. Stillman O-Rings and seals are being specified for sealing applications which a few years ago would have been impossible to satisfy. Stillman continues to meet the demands for tomorrow's sealing concepts.

STILLMAN RUBBER COMPANY

CULVER CITY, CALIF. / CLEVELAND, OHIO / ENGLEWOOD, N. J.

D SYSTEMS

Pumps for all Fluids

The TAPCO Group, the leading designer and manufacturer of fluid systems in the United States, has developed, built, and tested centrifugal pumps for all types of fluids. Six of these TAPCO pumps are illustrated at left.

These pumps, combined with other TAPCO fluid system components and accessories, provide completely integrated, single-source fluid systems at low cost, supported by TAPCO's excellent field service organization.

TAPCO's capability makes possible numerous new applications for booster pumps, including VTOL and STOL aircraft, ground effect vehicles, tanks, surveillance and observation equipment, jet-powered drones, and hydrofoils.

TAPCO GROUP

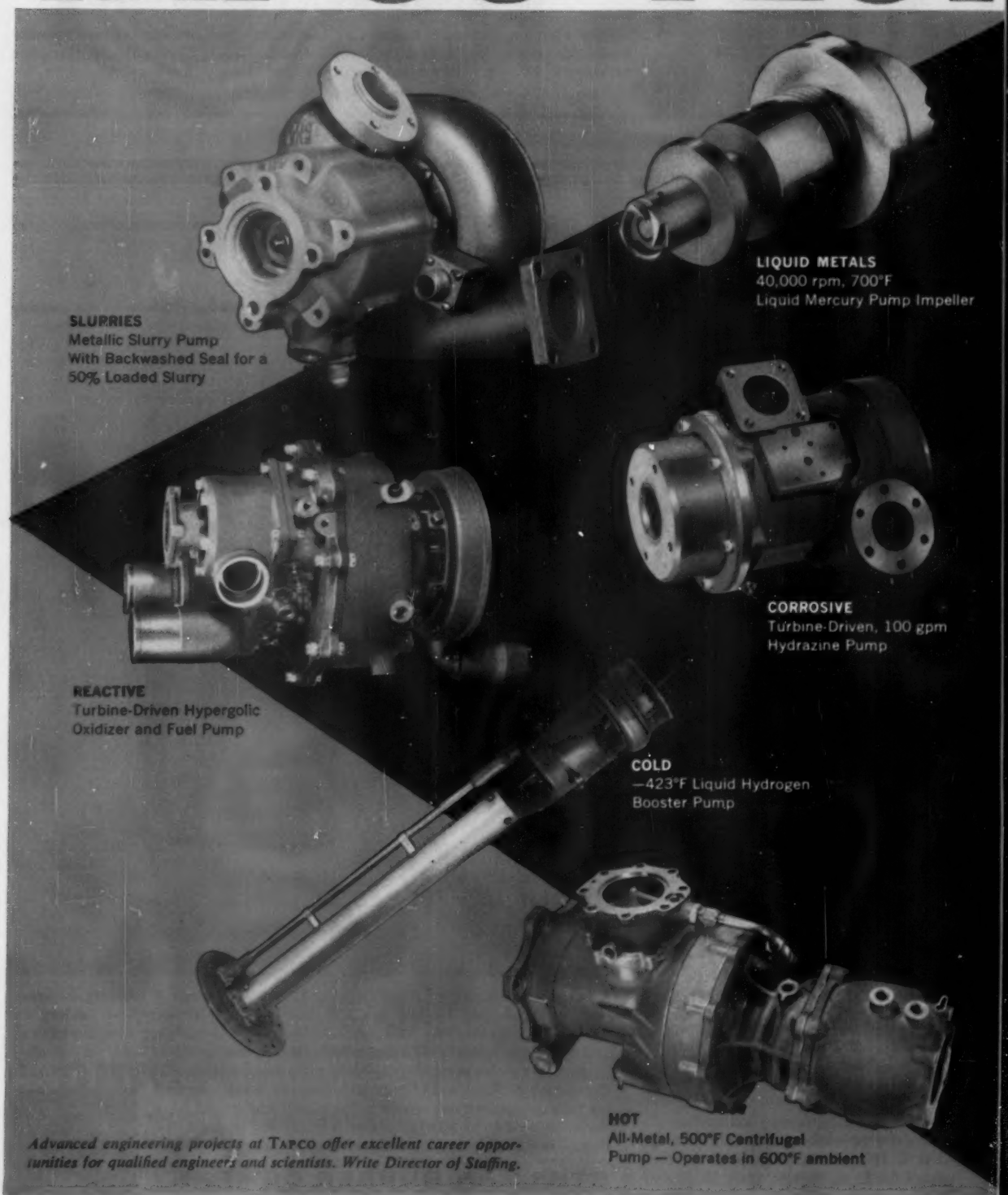
Thompson Ramo Wooldridge Inc.

DEPT. AW-660, CLEVELAND 17, OHIO

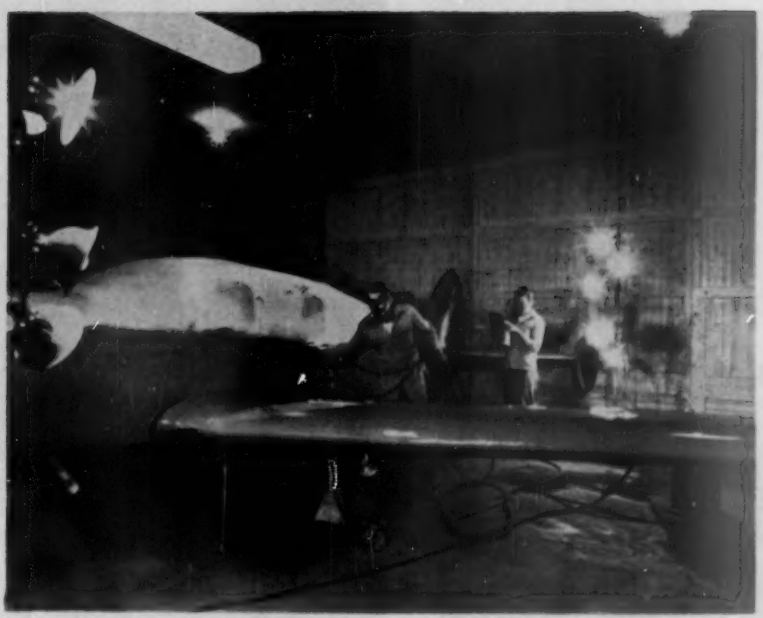
TAPCO GROUP EXPORT REPRESENTATIVE: AMERICAN AVITRON, INC., MAMARONECK, N.Y.

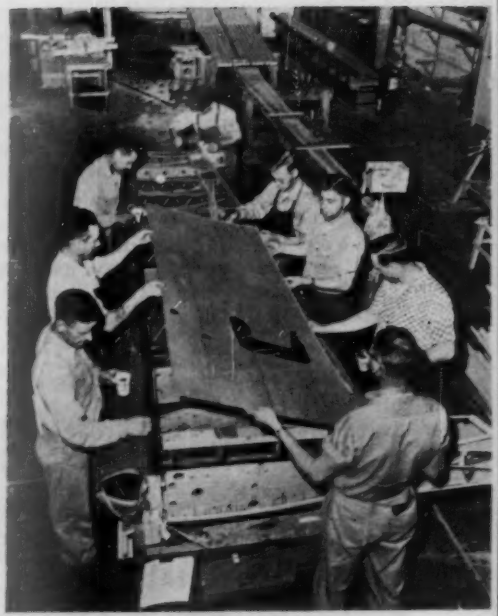
DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

TAPCO FLUI



Advanced engineering projects at TAPCO *offer excellent career opportunities for qualified engineers and scientists. Write Director of Staffing.*





PAINT SHOP at plant at Alexandria (Minn.) Airport is shown at left. At right, Bellanca 260 wing is covered with 2/16-in. mahogany plywood which is laminated to gain bend quality. After gluing and temporary tacking, wing is dipped in resin tank for sealing.

($22,800), and Cessna 210 ($22,450). Downer does not attempt to match either production facilities or advertising and promotion budgets with these builders, relying more on aggressive field sales tactics and word of mouth to sell the plane.

All told, the Cruisemaster cost to the owner, with optional equipment including a full gyro panel and radio equipment, etc.—would range from $22,900 to $24,900.

Downer Aircraft does no financing, leaving that phase of the operation to its distributors and dealers.

It is a source of particular pride to Downer Aircraft that Federal Aviation Agency has yet to issue an Airworthiness Directive for the 260, requiring either builder or operator compliance to remedy a defect.

Continental Engine

The Cruisemaster is powered by a 260 hp. Continental IO 470-F horizontally opposed, fuel injection engine; because of this feature, need for carburetor heat is eliminated. Fuel is 100/130 octane. Major design changes include:

- **All-plastic fuselage covering,** called Plasti-Kote, which the company says has saved about 30 lb. in weight and provided considerably more strength and life than the previous balloon cloth-Fiberglas combination fabric.
- **Redesigned engine mount** designed to reduce longitudinal stresses and vibration caused by high compression powerplants and high rpm. settings.
- **Ventilation system** has been channeled from the left wing air intakes to a system on the pilot's side, offering

CRUISEMASTER'S 260-hp. Continental IO 470-F engine uses fuel injection. Nose gear is steerable through rudder pedals. Gear is hydraulically powered and cycles in 4 sec.

FOUR-PLACE 1960 Bellanca 260 sells for basic price of $18,990. Optional equipment might raise price to $24,990.

Aviation Week Pilot Report:

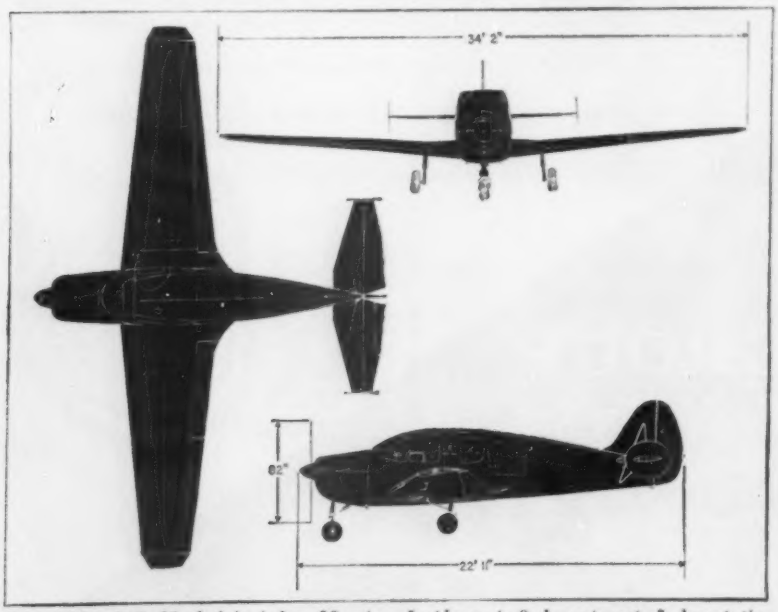
Bellanca 260 Flies Well at Varied Speeds

By Herbert J. Coleman

Teterboro, N. J.—Wide speed range—varying from a stall at 48 mph. to a 200-plus high cruise indicated airspeed at 6,500 ft.—characterizes the 1960 four-place Bellanca 260 Cruisemaster, a single engine airplane utilizing plastics, wood and steel tubing.

Compact, and yet comfortable, the 1960 Model Bellanca retains the Bellanca all-wood wing concept, unchanged since the Bellanca Cruisair first flew in 1936, but has moved into a new fuselage covering, tricycle landing gear and redesigned cabin. Gross weight is 2,700 lb.; useful load is 1,010 lb.

The Cruisemaster is produced at Alexandria, Minn., by Downer Aircraft Industries, Inc., on a 12-per-month production schedule. Downer Aircraft's 130-man work force has been in-house trained in aircraft production by top management, which originally planned to build the Republic Seabee under license (AW Mar. 10, 1958, p. 81).



BELLANCA 260 dihedral is 4 deg. 30 min. Incidence is 0 deg. at root, 3 deg at tip.

Downer Aircraft still owns the Seabee rights but has concentrated on building the Bellanca since the 260 rights were purchased from aviation pioneer Giuseppe Bellanca. Now retired, Bellanca still keeps an on-the-sidelines interest in the plane, making trips to Alexandria whenever any design changes are considered (as when the 260 changed to tricycle gear).

The Minnesota firm is headed by J. K. Downer, a former Saginaw, Mich., industrialist who founded the Scientific Brake Co. and entered the aviation field when he purchased a majority interest in Northern Aircraft, Inc., from Roy L. Strong, of Alexandria, who is no longer associated with the company. Robert Clagget is chief engineer and test pilot.

Acceptance of the Bellanca 260 in the business flying and executive market is indicated by its production rate, increased recently from 10 to 12 a month. Downer Aircraft sold 80 airplanes last year and present indications are that the figure will be topped this year.

Downer Aircraft follows what it calls "no planned obsolescence," i.e., changes in models are not drastic and for style purposes alone. Company said this procedure tends to "stabilize and maintain the [260] values and prices of those units now on the market," keeping resale value high. The firm now has 16 distributors.

The Cruisemaster sells for a basic price of $18,990, a cost that makes it competitive with the basic prices of the Beech Model 33 ($19,995); Piper 250

better air flow and control. Outlets, with controls, have been provided for both front and rear seat areas.

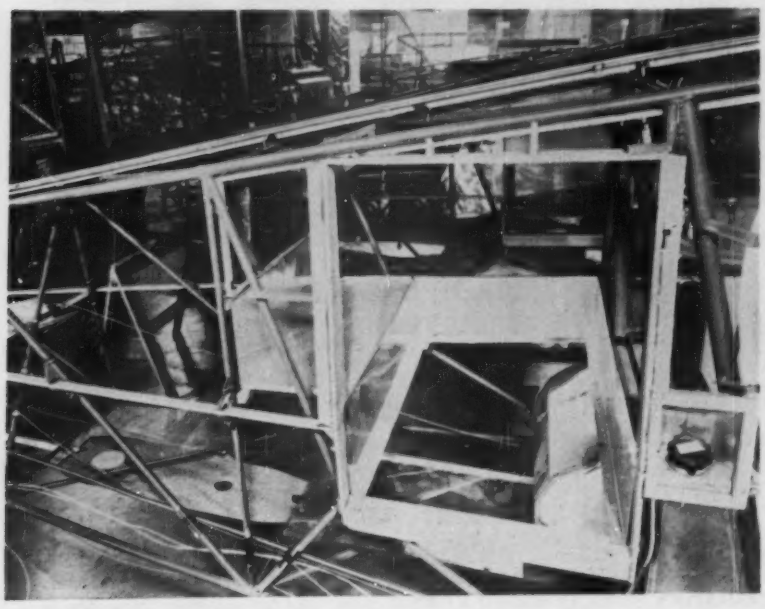
• **Rear seat back** has been made higher and 2 in. more head room, plus an inch or so shoulder room, has been added. Passengers also now have access from the rear cabin to the 186-lb. capacity baggage compartment behind the seat. Upholstery is nylon in varying shades.

• **Basic three-color** Bellanca design pattern has been retained, but the customer now can choose from 10 different colors.

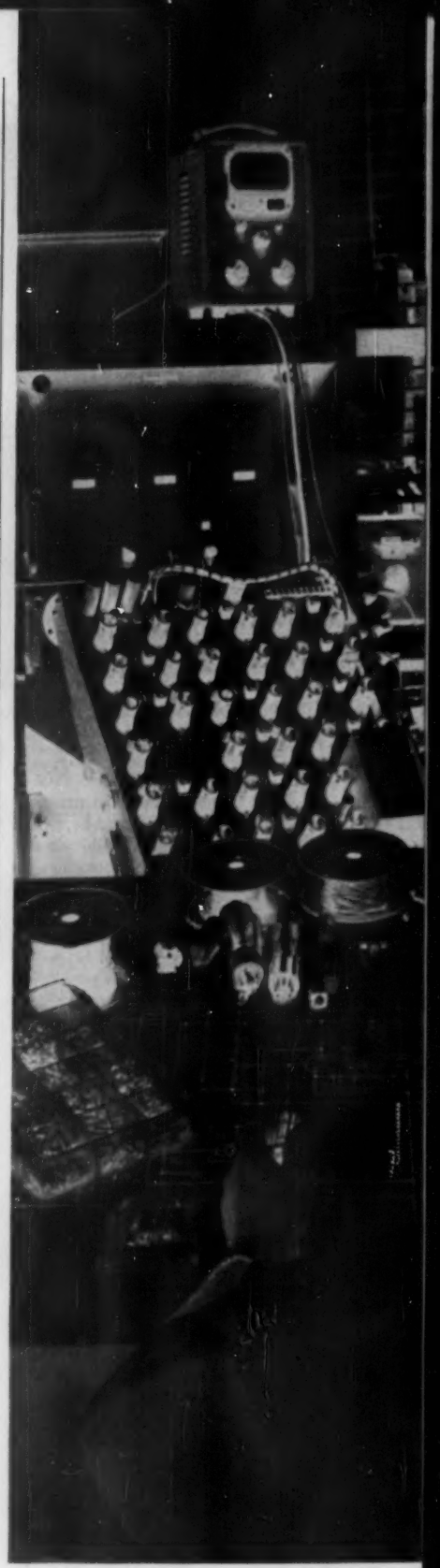
An evaluation by this AVIATION WEEK pilot, accompanied by David Nicoll, Downer Aircraft's eastern division sales manager, showed the Cruisemaster to be an honest, highly stable aircraft which is easy to fly and has good slow flight characteristics.

Plane flown at Teterboro Airport, N-7602E, was a new demonstrator with less than 500 hr. on the airframe and engine. On the ground, the 260 has a slightly nose-up attitude, caused primarily by a company decision to make the nose wheel the same size as the main gear for interchangeability and strength. Taxi visibility, however, is excellent.

Getting into the Bellanca is a bit tricky for the newcomer. First, he



FLAP SECTION for Bellanca 260 is assembled (above). Below is fuselage assembly, made of 4130 normalized steel tubing. Note auxiliary tank below baggage compartment.



EVOLUTION & REVOLUTION

REVOLUTION in electronics may have its genesis in the *evolution* and synthesis of four prime areas: the rapidly maturing technologies of semiconductor development and production, surface passivation and stabilization research, electronic ceramic engineering and controlled thin film deposition. Synthesis of effort in many scientific and engineering disciplines is required to achieve breakthroughs in these areas and accelerate the evolution from conventional to microelectronic circuitry. The Solid State Electronics Department of Motorola's Military Electronics Division is exploiting this approach as the key to long life and reliable performance of electronic equipment by eliminating excessive complexity in component interconnection.

RELIABILITY improvement demands a reduction in the number of point-to-point connections used in equipment design. Highly specialized engineers, physicists and chemists, at Motorola, are making significant contributions to the new art of non-topological integrated circuitry. All well-qualified scientists and technicians seeking professional growth will find stimulation and challenge in the Motorola Solid State Laboratories.

RECOGNITION and reward will be won by those who, by disciplined research in integrated circuits, help secure unconditional reliability. Write to the office in the area of your choice.

Military Electronics Division

CHICAGO 51, ILLINOIS
1450 NORTH CICERO AVENUE
SCOTTSDALE, ARIZONA
8201 EAST McDOWELL ROAD
RIVERSIDE, CALIFORNIA
8330 INDIANA AVENUE

The 88 windows of the new Convair 880 jet airliner are triple-glazed with PLEXIGLAS *acrylic plastic. Two of the three panels in each window are stretched* PLEXIGLAS 55, *permanently bonded together to form the outer section; the third, inner, panel is transparent grey* PLEXIGLAS II.

PLEXIGLAS

...aviation's standard transparent plastic

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Company of Canada, Ltd., West Hill, Ontario.*

PLEXIGLAS *is a trademark, Reg. U.S. Pat. Off. and in principal countries in the Western Hemisphere.*

"WHERE THERE'S PROGRESS, THERE'S PLEXIGLAS"

Specifications
Bellanca 260

Gross weight	2,700 lb.
Empty weight	1,690 lb.
Useful load	1,010 lb.
Wing span	34.2 ft.
Length	22.11 ft.
Height	9 ft.
Wing area	161.5 sq. ft.
Wing loading (gross weight)	16.7 psf.
Power loading (gross weight)	10.4 psf.
Cabin length	10.2 ft.
Cabin width	43 in.
Baggage compartment	12.08 cu. ft.
Baggage loading	186 lb.
Fuel capacity (wing tank)	40 gal.
Fuel capacity (auxiliary tanks)	20 gal.
Oil capacity	12 qt.

Engine: Continental six-cylinder IO-470-F, 260 hp. at 2,625 rpm., with fuel injection.

Propeller: (optional) McCauley or Hartzell constant speed, 82 in. dia.

steps on the right wing, grasping a handhold built into the upper fuselage. By holding a crossbar forward of the door (part of the tubular design for added safety in case of a flipover), the pilot swings himself across the cabin to the left seat. There is ample leg and headroom, once seated, for even a six-footer.

The flight panel is well designed for access and visibility. Starting controls (auxiliary fuel pump, master switch and starter) are centered above the throttle and propeller pitch control. Radio controls are on the copilot's side and flight instruments are in front of the pilot; this aircraft was fitted with dual controls and an inverted "W" wheel.

Switch was turned to both magnetos and, after activation of the fuel pump and cracking the throttle, starter button was pushed and the powerplant fired up, going smoothly into the green.

Gusty Day

It was, in a way, an excellent day for a flight evaluation. Surface winds were 25 kt., with gusts to 30 and 35 kt., and Teterboro Tower warned of turbulence to 7,000 ft., where two-third cloud cover began. The 260, which has a nose gear steerable by rudder pedal pressure, taxied easily, despite the strong winds and gusts.

At the intersection of Runway 24, we stopped for an engine runup of 25 in. manifold pressure and 2,500 rpm. Both magnetos checked out (100 rpm. drop is allowed) and we ran the propeller through before taxiing onto 24 for takeoff.

Takeoff was made at full power (25 in. manifold pressure and 2,550 rpm.) and the airplane was off the ground in about 300 ft. (As Nicoll demonstrated later, in a high performance takeoff, the Bellanca can get off in about 180-

These *Scott* Aircraft Products Contribute to Your Safety

WINDSHIELD CLEANER

with convenient squirt top for plastic windshields. Restores and maintains flexibility, prevents crazing and cracking. Even restores visibility to old windshields by removing mild scratches.

MODEL 3200 TAILWHEEL

Insures smooth easy taxiing and landings even on rutty fields. 8" pneumatic tire fits Piper, Stinson, Cessna, Aeronica, Luscombe, Globe, Temco Swift, etc.

2716 AIR TEMPERATURE GAUGE

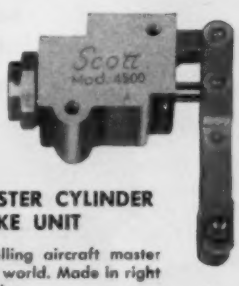
Easily installed through plexiglass windshield or cowling on most aircraft. Centigrade and Fahrenheit graduations.

MODEL 3-24-B TAILWHEEL

Automatic, steerable and full swivel. Has 6" solid rubber tire. Standard equipment on more than 70,000 aircraft: Luscombe, Piper, Taylor craft, Aeronica Champion and Chief, Stinson and others.

4408 MASTER CYLINDER

Has integral parking brake. For toe pedal installation. Standard equipment on thousands of popular aircraft. Has positive parking brake lock lever. Light, yet strong and dependable.



4500 PARKING BRAKE VALVE

Other models available as gas line shut-off valves, pneumatic pressure on-off valves and others.

B-711 MASTER CYLINDER BRAKE UNIT

The largest selling aircraft master cylinder in the world. Made in right and left models.

Scott also manufactures other aviation products that contribute to safety for business aircraft as well as commercial and military aircraft. Scott Oxygen Systems are known the world over for their high standards of perfection. Write for complete information.

SINCE 1937 Scott FOR SAFETY—FOR SERVICE

SCOTT AVIATION CORP.

275 ERIE STREET • LANCASTER, NEW YORK

Export: Southern Oxygen Co., 250 W. 57th St., New York 19, N.Y.

West Coast Office: Fulton-Ventura Bldg., 13273 Ventura Blvd., Studio City, Calif.

LETTERS WE'D LIKE TO RECEIVE....

Mr. W. M. Tynan
Administrative Engineer
The Kaman Aircraft Corp.
Bloomfield, Conn.

Dear Sir:

I am a graduate engineer with considerable experience in the following:

1. Automatic stabilization equipment for rotary wing aircraft.
2. Servomechanisms.
3. Automatic flight controls.
4. Avionic systems development.
5. Remote guidance systems.

I have read with interest the work that Kaman is doing in the development of its own stabilization and navigational equipment for the all-weather HU2K helicopter which Kaman is producing for the Navy. I am also very interested in the advanced work Kaman is doing in the drone helicopter field.

Accordingly, I would like to be considered for a position with Kaman which would take full advantage of my technical and administrative abilities.

My resume is attached.

Sincerely,

If you can write a letter like this, please do it immediately. Kaman would like to have you aboard. Many attractive positions are waiting to be filled by men looking for a ground floor opportunity.

THE KAMAN AIRCRAFT CORPORATION
BLOOMFIELD, CONNECTICUT
Largest independent producer of rotary wing aircraft in the U.S.A.

Bellanca 260 Performance

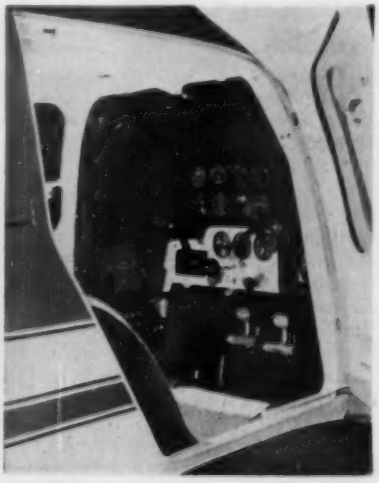
Maximum cruise speed: 75% power (at 9,000 ft.)	203 mph.
Economical cruise (45% power at 9,000 ft.)	166 mph.
High speed (sea level, full throttle	208 mph.
Never exceed speed (V_{ne})	230 mph.
Rate of climb (sea level)	1,750 fpm.
Service ceiling	22,000 ft.
Stall speed (landing configuration)	49 mph.
Stall speed (gear and flaps up)	57 mph.
Cruising range (51% power, 9,000 ft., 179 mph. TAS):	983 mi.
Takeoff run (0 deg. flaps) sea level, zero wind	390 ft.
Landing run (30 deg. flaps) sea level, zero wind	460 ft.
Takeoff distance to 50 ft., no flaps, zero wind	400 ft.
Landing distance over 50 ft., full flaps, zero wind	450 ft.
Landing speed	49 mph.

200 ft. although the stall warning was sounding as we pulled off the runway.)

Gear is hydraulically powered and cycles in only 4 sec. When retracted, the wheels protrude slightly as a safety factor in case of a wheels-up landing.

Climbout was made at approximately 110 mph. and 1,500-1,700 fpm. The Cruisemaster can climb at a surprising angle and, despite extreme turbulence, we climbed to 6,000 ft. in a few minutes. The turbulence contributed to the evaluation, in that the airplane corrects itself from any off-level angle it is forced into. At times the Cruisemaster could be flown hands-off through the turbulent areas.

At 6,500 ft., where temperature was 16C, we leaned the engine to 45%



ACCESS to both front seats in the 260 is through the right door. Power controls are on white panel.

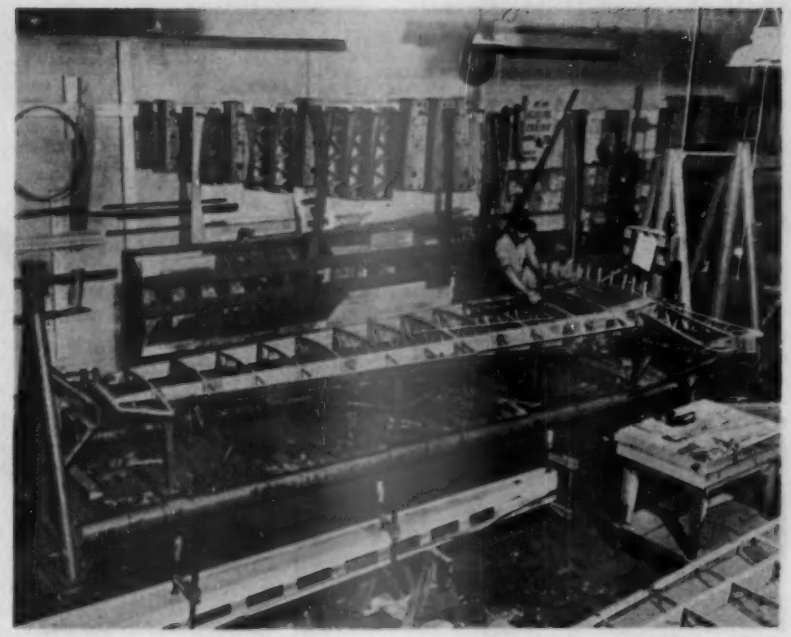
power for a long-range cruise speed check, using 2,000 rpm. and 20 in. manifold pressure. The airplane stabilized at 183 mph. true airspeed. At 75% power, using 24 in. manifold pressure and 2,450 rpm., the plane's true airspeed was slightly more than 200 mph.; a more exact reading was impossible due to fluctuations in the airspeed indicator caused by the turbulence.

The Bellanca handles favorably in the stall areas. For one thing, the plane must be forced into a stall, and this is only accomplished after putting the plane in an angle so steep as to become uncomfortable—in our case, what appeared to be slightly more than 45 deg.

The Cruisemaster is fitted with a stall warning indicator (horn) activated by a probe on the left wing. The horn sounds about 10 mph. before the stall is reached.

On a clean stall (gear and flap up, carrying 10 in. manifold pressure) the Cruisemaster stalled at slightly under 50 mph. indicated airspeed. There was some buffeting, but no break; the pilot finally released the wheel, letting the nose drop through the horizon. The sharp up-angle, apparently, could have been held indefinitely without a break, although the Cruisemaster mushed slightly.

With gear down and full flaps (46 deg.), and using 10 in. manifold pressure and 2,000 rpm., the stall warning horn sounded at 58 mph. and again the plane reached stall point at under 50 mph. This time there was a slight break to the right—but the Bellanca corrected itself.



WING is built up at factory in downtown Alexandria, Minn. Here ribs are being glued to the spars. Humidity and temperature are controlled during gluing and curing.

The Bellanca's slow flight capabilities are excellent. For instance, setting up the speed at 65 mph. IAS (10 in. manifold pressure and 1,700 rpm.), the plane was trimmed nose high. It immediately started a gentle turn to the left, losing altitude at about 500-600 fpm., a condition ideal for letting down through overcasts. The left turn remains just that—it does not degenerate into a sharp spiral.

It also can be flown hands off during this maneuver. Flight visibility is excellent, although the position of the two upper crossbars mentioned earlier are somewhat annoying.

Noise level is moderate and a conversation can be held at slightly higher than normal tones at 75% cruise power.

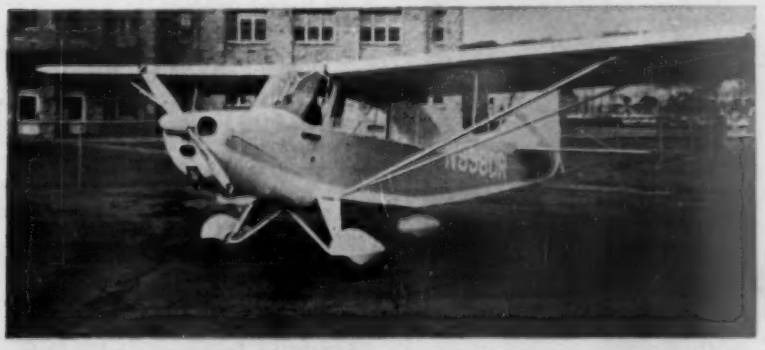
Plane has a fixed rudder trim tab; the elevator trim is located above the windshield and is operated by a left-right crank. There is a tendency toward confusion for the unfamiliar pilot, since the indicator is fore and aft and is hard to read; reaction at first is to trim the plane the opposite way from desired.

Gusty Wind

Surface wind conditions remained strong and gusty—still 20-25 kt. and 15 deg. off the active runway—when we returned for landing. Entering traffic, speed was reduced to about 130 mph. and gear lowered; lever is on the floor between the pilots and incorporates a metal hook to guard against inadvertent raising. Both gear and flap lever (located just to the right) return to neutral positions after activation.

Pattern was flown at 125 mph., faster than usual because of turbulence, and we dropped about 15 deg. flap on final, making a fairly flat approach with considerable crab to keep the approach heading constant. A gust hit on flareout, pushing the 260 to the left side of the runway, but the plane remained controllable and contact was made at about 70 mph. Landing roll was short. Main gear wheels lean in slightly at the top for ground stability in crosswinds.

On the maximum performance take-



Champion Model 7JC Has Steerable Tail Wheel

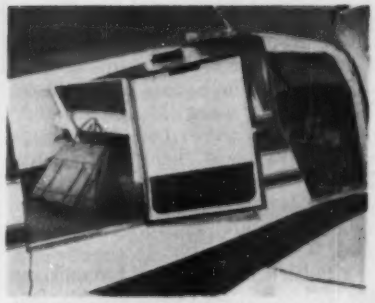
Champion Model 7JC Tri-Con has tricycle landing gear with tail wheel which is steerable through the rudder pedals when on the ground. In flight the rear wheel automatically assumes a straight-ahead position. This tricycle layout is suited to rough-field operation, according to Champion Aircraft Corp., Osceola, Wis. The gear also overcomes the tendency of a conventional tricycle-gear aircraft to tip in a quartering tailwind, Champion says. In a normal landing all wheels touch almost simultaneously. All three wheels have long-stroke oleo shock absorbers. If the rear wheel touches down first, the shock absorbers of the two front wheels will begin absorbing the landing impact before the rear wheel's shock absorber is fully compressed. The positive-caster rear wheel opposes sideward forces in crosswind, Champion says. Basic retail price of the 7JC, which is produced only in a de luxe version, is $6,695.

off, Nicoll dropped 15 deg. flap and used full power, holding brakes on. When brakes were released, Nicoll hauled back on the control column and the Bellanca was off the ground in about 180 ft. at about 50 mph. We were 500 ft. high at the end of the 5,000 ft. runway, climbing at nearly 2,000 fpm. at 95 mph. There was no sink when flaps were raised.

Next landing was made at a higher approach speed (about 110 mph.) and higher final approach angle to cut the necessary crab; plane settled onto the runway smoothly and again the landing roll was quite short.

Optional equipment includes installation of a Mitchell automatic pilot; three-control unit—roll, pitch and bank—with an automatic heading selector and altitude control costs $3,120. Downer Aircraft also offers a variety of communication and navigation equipment; plane flown by AVIATION WEEK, for instance, was fitted with a Narco Mark II Omnigator with 27-channel VHF transmitter and overhead speaker which costs $1,255.

Auxiliary fuel tank (20 gal.) also is optional, at $265 installed. Total fuel capacity with auxiliary tank is 60 gal., giving a specified range of 913 mi. at 44% power (10,000 ft., 18 in. manifold pressure and 2,000 rpm.).



BAGGAGE COMPARTMENT has 186-lb. capacity, is accessible from passenger cabin.

The Bellanca 260 is built in a plant at Alexandria Airport, although the wood wing is manufactured at a downtown location and trucked to the plant. Wing is a two-spar structure made of sikta spruce which is shipped to Downer Aircraft from Alaska. Dihedral is 4 deg. 30 min. and incidence is 0 deg. at the root and 3 deg. at the tip.

After the wood is inspected for knots and cracks, select pieces are chosen for spar construction. Strips 16 ft. long x 1⅞ in. are laminated but between each lamination, the grain is staggered or reversed for increased strength. Net result, the company says, is a piece of spar stock which is about 400% stronger than the original piece of wood. Strips being laminated are kept under pressure for 24 hr.; humidity is controlled to 70 deg. Front and rear spar weights are equalized. In order to provide fitting plates for the main landing gear on the rear spar, additional lamination is made by thickness blocks about 1¾ in. and 1⅞ in. on the inboard side.

Entire wing is covered with 2/16 in. mahogany plywood which is laminated to gain bend quality. After gluing and temporary tacking, the wing is dipped in a resin bath for firm sealing. There is no induced drag from protruding rivet heads or dimpled spot welds, as with a metal wing.

Downer Aircraft says the new Plasti-Kote fuselage covering has a high degree of strength; temperature variations, even in the environmental extremes, have no effect on the covering. Standard strength test is to drop a ¾-lb. steel ball onto the covering from 60 in., to check quality.

The company says it has dropped the steel ball from 30 ft. without puncturing the skin, which also is said to have a high tear resistance.

Fiberglas is used in construction of the two-part engine cowling, for another weight saving. Cowling is secured with quick-access fasteners.

The 260 fuselage is made of welded 4130 normalized steel tubing, welded in a bridge-type structure.

Emergency spare parts in hand, Air Force pilot leaves Cessna U-3A supplier, one of many designated to serve USAF across America.

LOGISTICS PROBLEM—SOLVED BY CESSNA

Problem: to provide the Air Force a quick, easy, economical way to maintain its valuable fleet of Cessna U-3A light twin transports. Solution: a nationwide off-the-shelf support program tied in with Cessna's world-wide support of the U-3A's commercial counterpart, Model 310. In operation nearly three years now, the program has proved a success by many standards. Most important to the Air Force: untold time, trouble and dollars saved.

Low-cost logistics support is just one of the reasons USAF flies the U-3A extensively—and one more of the ways Cessna "Problem-Solving" Research is ever at work enhancing America's future in the air.

Wichita, Kansas

CESSNA

SINGLE-SEAT Fauvel AV-36 CM tailless glider exhibited at the recent Hanover air show was built under license by Apparatebau Nabern GmbH., Nabern/Teck, Germany. It is based on the French Fauvel AV-36 glider prototype. The French Fauvel company now has a two-seat version under development.

Tailless Glider Has Engine for Takeoff

By Edith Walford

Hanover, Germany—Single-seat Fauvel AV-36 CM tailless motor glider, based on the French Fauvel AV-36 glider prototype, was among the Bolkow-Entwicklungen K.G. exhibits at the Hanover air show.

Several Fauvel AV-36 gliders were produced and are flying in France and the French Fauvel company now has a two-seat version under development.

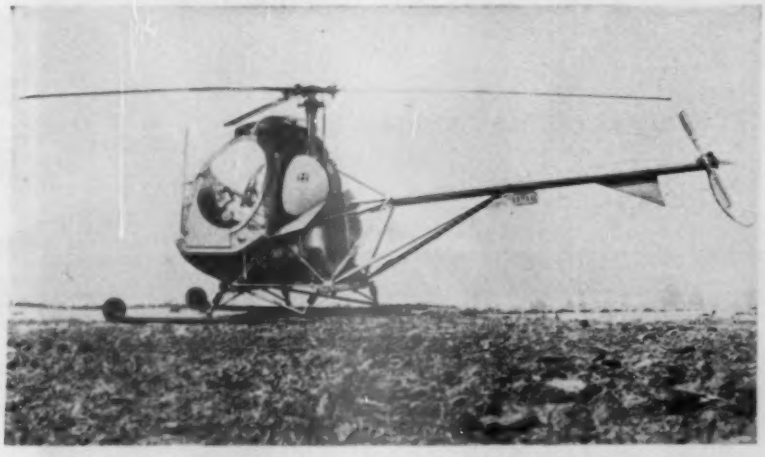
The model at Hanover was built under license by Apparatebau Nabern GmbH., Nabern/Teck, Germany, a member of the Bolkow group responsible for Bolkow's production program.

The glider is fitted with a 14-hp. lightweight, two-cylinder, two-stroke engine made by Kleinmotoren GmbH., Maichingen, Germany, which enables it to take off under its own power. Previous models had a single 11.4-hp. Kleinmotoren powerplant and required either a winch or towing airplane to become airborne.

The tailless Fauvel AV-36 CM has an unswept, single-spar wing and derives its longitudinal stability from wing twist and controlled location of the center of gravity. The elevator is mounted like a flap in the center section of the wing. The aileron control is conventional. The two rudder units are between elevator and aileron. The wing has a wooden spar and plywood-covered torsion box nose. The section behind the spar is fabric-covered; the

Fauvel AV-36 CM Data

Dimensions:	
Span	42½ ft.
Length	10½ ft.
Aspect ratio	11.5
Wing area	157.1 sq. ft.
Weights:	
Empty weight	348 lb.
Useful load	202 lb.
Gross weight	550 lb.
Performance:	
Best glide ratio	25
Minimum rate of sink	2.95 fps.
Maximum speed in horizontal flight near the ground	74.5 mph.
Maximum rate of climb	4.9 fps.
Duration of powered flight	3 hr.



Hughes 269A Powered by 180-hp. Lycoming

Hughes 269A, civil version of Army YHO-2HU (AW Apr. 4, p. 88), is 22 ft. 3 in. long, 7 ft. 11 in. high and has a fuselage width of 4 ft. 3 in. Design gross weight is 1,550 lb.; empty weight is 867 lb. Cruise speed is 85 mph. Operational range is 220 mi.

rudder units are of similar construction.

The steel-tube fuselage is normally covered with fabric or synthetic material, as desired. The single-seat cockpit has a Plexiglas canopy. Both the pilot's seat and control pedals are adjustable. The single track landing gear has two wheels mounted in tandem under the fuselage. The rear wheel has brakes.

The engine is installed behind the main spar in the center of the fuselage. It drives a two-blade, 4.2-ft. diameter, automatically folding propeller to reduce drag when the engine is switched off. The engine is blower-cooled and rated at 14 hp. at 5,000 rpm.

Fuel container holds 4.75 gal.

PRIVATE LINES

Garrett Corp.'s AiResearch Aviation Service Division, Los Angeles, is fitting Minnesota Mining & Manufacturing Co.'s Convair 340 with an executive interior, special Minnesota Mining sound damping treatment and a Sperry A-12 autopilot. Company's chief pilot is Frank Thera.

April shipments of U.S. business and utility aircraft totaled 711 units valued at $14,454,000, at manufacturers' net billing prices, compared with 701 aircraft valued at $11,960,000 in the same month last year. April, 1960, shipments included 120 twin-engine aircraft. In the first four months of this year, a total of 3,044 business and utility aircraft valued at $59,087,000 have been delivered compared to 2,653 units valued at $44,024,000 in the same period in 1959.

Recent Bell Helicopter purchasers include Bay Aviation Services, which received a de luxe Model 47J-2 Ranger for general charter work in the San Francisco-Oakland, Calif., area. Bay Aviation will operate from San Francisco International Airport to that city's municipal airport on the ferry building docks to the privately-owned Harney Heliport at Candlestick Park and to Bay Meadows race track. Inter-Mountain Helicopters, Inc., a newly-formed service in Idaho, received a Model 47G-3, which it will initially use on charter to U.S. Forestry Service. Aero-Boeing, Inc., Seattle, Wash., has added a Model 47G-3 to its fleet, totaling 15 Bells, which the company uses for timber spraying, seeding, geological work and snow surveys.

Hungarian lightplane, the low-wing D-20 Pajtas, powered by a 110-hp. Walter Minor inverted engine, has completed its flight tests. Single and two-seat versions have been designed. Specifications include—span, 34.8 ft., length 26.1 ft., wing area, 172 sq. ft. Gross weight is stated to be 1,760 lb. and empty weight is 1,144 lb. Maximum speed is given as 124 mph. and range as 310 mi. Airplane closely resembles the Czech Z-226 trainer.

Increase of 30% in commercial plane sales for the first half of Fiscal 1960 are reported by Cessna Aircraft Co. Sales of $30,609,000 for the six months ending Mar. 31 are compared with $23,497,000 for the same period last year. Cessna sales by all divisions for the six months period totaled $56,314,000, a 7% increase over the same period in Fiscal 1959. Earnings after taxes were $4,232,000, or $1.31 per share.

Contract to do periodic overhaul of National Airlines' Pratt & Whitney JT-4 turbojet engines and basic accessories has been awarded by the carrier to Southwest Airmotive Co., Love Field, Dallas, Tex. Southwest Airmotive expects to get its first National JT-4 early this summer. It previously had contracted with Braniff Airways to handle its JT-4s.

Piper delivered 226 business and utility airplanes in April having a total factory billing value of $3,499,218. Included in April shipments were 18 PA-18s, 11 PA-18-As, 39 PA-22 Tri-Pacers and Caribbeans, 48 PA-23 Az-

miller
NEW MILLER CONSTANT POTENTIAL D-C WELDER CP-3-VS
X-ray perfect MIG welds on aluminum, magnesium, stainless and carbon steel sheets down to .030" are the routine result with the New Miller Constant Potential, CP-3-VS. Continuous slope and voltage adjustment even during the course of the weld means that the operator is able to "tune in" the desired settings. There's no burn-through; there's no spatter. Actually, a new performance high in low voltage welding is established with the introduction of this welder with its broad range of from 300 amps at 30v to 25 amps at 10v. * Complete specifications, as well as recommendations for your particular application problems, will be sent promptly upon request.
miller ELECTRIC MANUFACTURING CO., INC., APPLETON, WISCONSIN
Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

IN TOUCH WITH NEW DIMENSIONS

Another achievement of IBM Applied Scientists: general computer program for job shop simulation

Creating imaginative solutions to problems never solved before is a job of IBM Applied Science Representatives. Through unique applications of data processing, they are exploring new dimensions in engineering, the sciences, and business.

One team of Applied Scientists, for example, worked closely with customers to simulate industrial job shop operations on a computer. A general program for this purpose allows firms to pre-test changes in production scheduling.

Other Applied Science Representatives are working on design analysis, forecasting, problems of mathematical computation, and process control. The range of projects is unlimited.

You may play an important and rewarding part in this stimulating profession. There are openings in many cities for men and women with advanced degrees in engineering, mathematics, or a physical science, or a degree in one of these areas plus a Master's in business administration or experience in programming.

For a confidential interview, please call any IBM Branch Office or one of these Regional Managers of Applied Science:

L. M. Fulton
IBM Corporation
425 Park Avenue
New York 22, N.Y.

R. W. DeSio
IBM Corporation
618 S. Michigan Ave.
Chicago 5, Ill.

L. C. Hubbard
IBM Corporation
3424 Wilshire Blvd.
Los Angeles 5, Calif.

DATA PROCESSING DIVISION **IBM.**

Which of these Craig skills and services can help you?

- **Systems housing** — light weight, high strength aluminum shelters, vans and trailers.
- **Systems components** — telescoping antenna masts, transit cases, cabinets, equipment racks.
- **Systems installation service** — layout and installation of transportable systems, through final checkout.
- **Systems packaging research** — engineering design and development for ground support and electronic equipment protection.
- **Complete production facilities** — to handle your complete packaging assignment.
- **A unique "aluminum-chemical research" service** — engineering "brainpower pool" for solving virtually any problem in aluminum and foamed plastic fabrication.

WRITE TODAY FOR CRAIG'S NEW COMPLETE 16 PAGE CAPABILITIES BROCHURE

Craig SYSTEMS, INC.

Dept. B-8, 360 Merrimack St., Lawrence, Mass. - Tel. MUrdock 8-6961

Business systems and equipment are another Craig specialty through LeFebure Corporation, Cedar Rapids, Iowa — a Craig subsidiary.

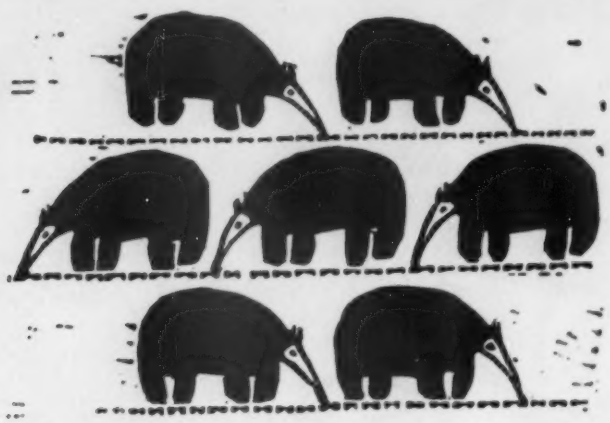
U. S. Business & Utility Aircraft Shipments

March 1960

Manufacturer and Model	No. of Units	Net Billings
Aero Design 500	1	$1,038,000
560E	1	
680E	11	
Beech 185	9	$4,494,000
65 Queen Air	2	
33 Debonair	28	
35 Bonanza	41	
50 Twin-Bonanza	11	
95 Travel Air	17	
Callair A-5	3	$38,000
A-6	1	
Cessna 150	23	$6,203,000
172	89	
175 & Skylark	50	
180	25	
182 & Skylane	80	
210	89	
310C	35	
Champion 7EC Traveler	2	$137,000
7FC Tri-Traveler	5	
7GC Sky-Trac	2	
7JC Tri-Con	10	
7HC DX'er	4	
Mooney Mk. 20	11	$211,000
Piper PA-18	23	$4,181,000
PA-18-A Super Cub	9	
PA-22 Tri-Pacer & Caribbean	62	
PA-23 Apache 160	2	
PA-23 Aztec 250	44	
PA-24 Comanche 180	42	
PA-24 Comanche 250	56	
PA-25 Pawnee	42	
Totals	821	$16,190,000

First quarter 1960 shipments of business and utility aircraft are 20% higher than the same period last year, with 2,333 planes shipped in the first quarter of this year compared with 1,952 units delivered in the same period of 1959. Total net billings for the first quarter of this year were $44,033,000 compared with $32,064,000 for the same period in 1959.

PROBLEMATICAL RECREATIONS 18



What is the remainder upon dividing $5^{999,999}$ by 7?

—Fermat, circa 1635

The Advanced Devices Laboratory at our Airtron Division concentrates its efforts on establishing new frontiers in the microwave field. It is removed from the daily problems and responsibilities of production design and engineering.

ANSWER TO LAST WEEK'S PROBLEM: Colonel Downing.

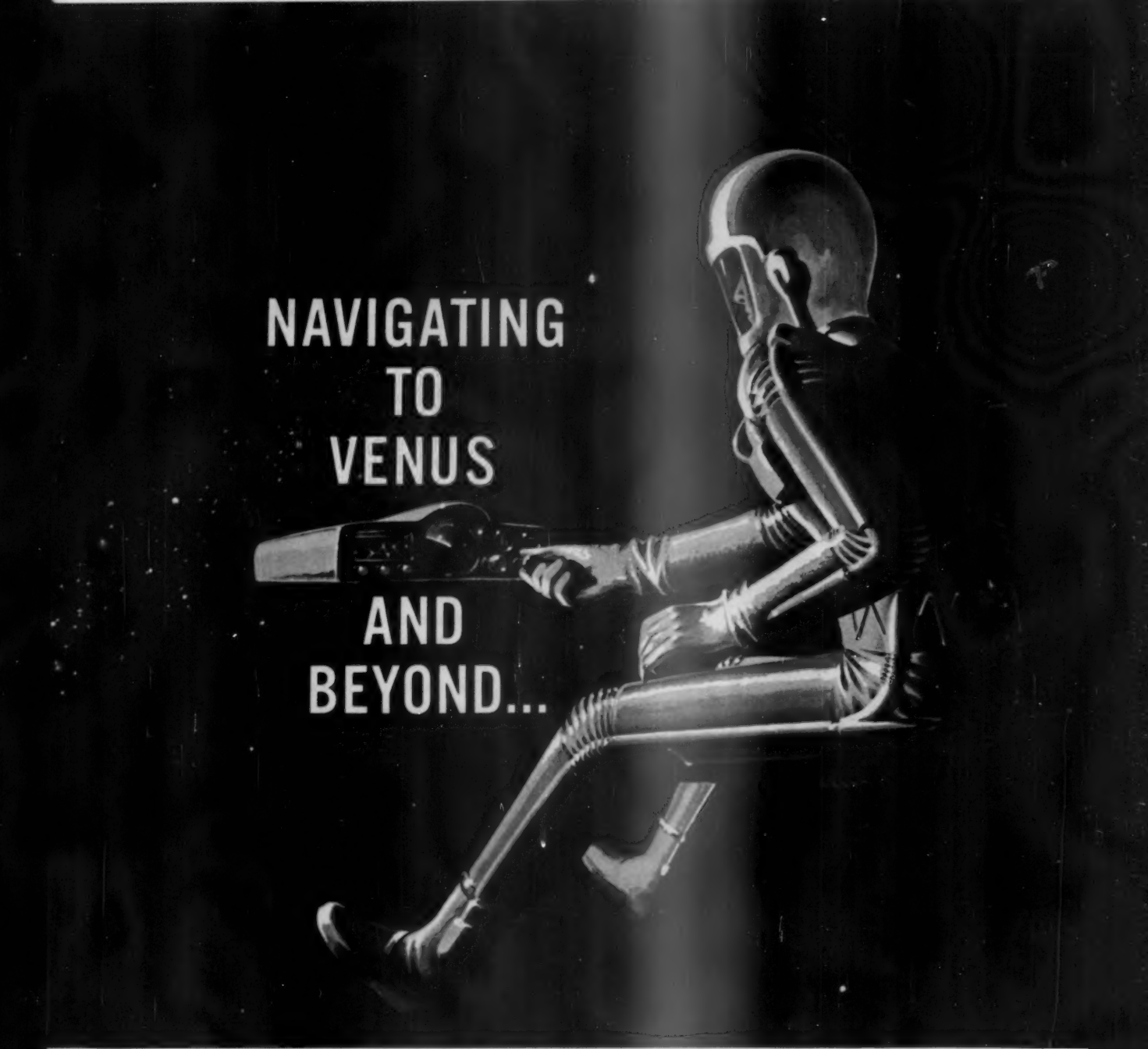
LITTON INDUSTRIES
Beverly Hills, California

tecs, 23 Comanche 180s, 29 Comanche 250s and 58 PA-25 Pawnee agricultural planes.

Service facility for business and private planes will be established by Mid Continent Airmotive Corp. at the new Jefferson County Airport nearing completion 15 mi. northwest of Denver, Colo. Mid Continent's facility will include 17 T-hangars in addition to two conventional hangars of combined 33,600-sq.-ft. capacity.

Federal Aviation Agency now makes its weekly publication "International NOTAMS" generally available for an annual subscription price of 52 issues for $3 for domestic mailing and $5 for overseas mailing. The publication, which provides Notice-to-Airmen service for planners of foreign flights, formerly was distributed at no charge to about 1,000 persons. The publication may be ordered from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Douglas DC-6B transport has been converted for executive use by Garrett Corp.'s AiResearch Aviation Service Division, Los Angeles. Airliner, which seats 36 passengers plus crew, has an integral ladder for entry at airports where suitable airline passenger ramps are not available.



A CHALLENGE TO EXCITE ANY ELECTRONICS ENGINEER WORTH HIS SALT... THE KIND RYAN NEEDS RIGHT NOW

We do not know where Venus is, within 50,000 miles or more. What is needed is a guidance system capable of injecting space vehicles into interplanetary orbits with the accuracy required for advanced space missions.

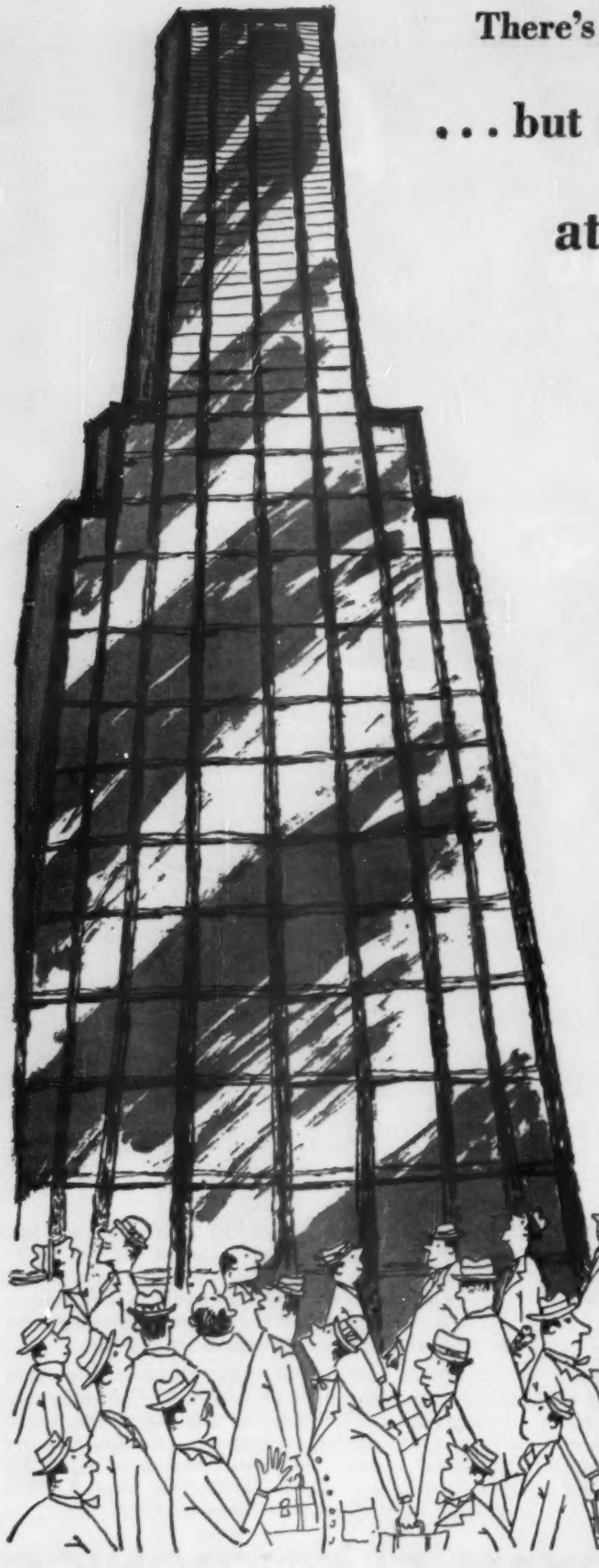
We are confident that the C-W doppler systems, of which Ryan is the world leader, will meet this challenge of space navigation. This is one reason Ryan is the largest electronics firm in San Diego – *and the fastest growing!* If you are an electronics engineer ambitious to help advance the art, as well as your own career, through vital "frontier work" – we want you *right now* at Ryan Electronics.

Ryan Electronics employs over 2000 people and has over one-third of the company's $149-million backlog of business. Under the leadership of some of America's most prominent scientists and engineers, Ryan is probing beyond the known . . . seeking solutions to vital problems of space navigation.

Expanding facilities of Ryan Electronics at San Diego and Torrance in Southern California are among the most modern in the West. You enjoy living that's envied everywhere, plus facilities for advanced study. Send your resume or write for brochure today: Ryan Electronics, Dept. 1, 5650 Kearny Mesa Road, San Diego 11, Calif.

DIVISION OF RYAN AERONAUTICAL COMPANY
SAN DIEGO & TORRANCE · CALIFORNIA

RYAN ELECTRONICS



There's plenty of room at the top

. . . but there's lots more room at the bottom

Look around you. How many men do you see at about your job level and income? Know them pretty well, don't you? Are they smarter than you are? Do they work any harder? Do they possess some "something" that you don't have?

No, of course they don't. And yet, five years from now, some few of you are going to be lots closer to the top of your company. There's lots of room up there — management needs able-brains as never before. But, warning! There's still lots more room at the bottom!

Is there a shorter, surer route to that better job, that bigger paycheck, that pride of achievement? There is, but it's no Easy Street. You still have to supply the energy and effort. How? By digging in zealously with a more intensive, regular reading of the magazine you're holding in your hand right now. Look ahead, read ahead, get ahead.

McGraw-Hill editors write it exclusively for you. Nobody else. It's all about you and your job and your problems. Nothing else. News, fact, trends — today's tasks and tomorrow's opportunities. As inspiring as it is informative. Reads lively. Keeps you on your toes. Makes important people notice you. What's more — you'll enjoy it . . . for it's just about as personal as any publication could ever hope to be.

McGRAW-HILL SPECIALIZED PUBLICATIONS

The most interesting reading for the man most interested in moving ahead

WHO'S WHERE

(*Continued from page 23*)

In the Front Office

Shelby Thompson, director of the Office of Technical Information and Educational Programs, National Aeronautics and Space Administration, Washington, D. C.

Chauncey W. Huth, chief of the Management Analysis Office of the National Aeronautics and Space Administration's George C. Marshall Space Flight Center, Huntsville, Ala.

Honors and Elections

Col. Arthur J. Wilde (USAFR), manager of the regional representatives office at Dayton (Ohio) for the Motorola Military Electronics Division, has been elected president of the National Aeronautical Electronics Conference (Naecon) for 1961.

The Royal Aeronautical Society has awarded Honorary Fellowships to **Sir George Edwards**, managing director of Vickers-Armstrongs (Aircraft), Ltd., and **Prof. W. J. Duncan**, professor of aeronautics and fluid mechanics at the University of Glasgow and chairman of the Aeronautical Research Council. Other honors awarded by the Society: The Gold Medal to **Sir Frederick Handley Page**, of Handley Page, Ltd., for "his outstanding contributions to British aircraft design for more than 50 years." The Silver Medal to **R. H. Chaplin**, of Hawker Aircraft, Ltd., for "his achievements in the design and development of military aircraft." The Bronze Medal to **H. G. R. Robinson**, of the Royal Aircraft Establishment, for "his work leading to practical achievement in ballistic missiles." The British Gold Medal for Aeronautics to **B. E. Stephenson**, of Vickers-Armstrongs (Aircraft), Ltd., for "his outstanding practical achievements in aircraft design and development." The British Silver Medal for Aeronautics to **Philip A. Wills**, of the British Gliding Assn., for "his practical achievements in the service of British gliding." The Wakefield Gold Medal to **E. G. Broadbent**, of the Royal Aircraft Establishment, for "his contribution to aircraft safety through the theory of aeroelasticity." The R. P. Alston Medal to **Wing Cmdr. R. P. Beamont**, of English Electric Aviation, Ltd., for "his practical achievement in flight testing supersonic aircraft."

The Chicago Assn. of Commerce and Industry has named **Juan T. Trippe**, founder and president of Pan American World Airways, recipient of the International Achievement Award for World Peace for 1960.

Changes

D. W. Hege, manager of the Advanced Design subdivision of Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif., has been named a consultant to the Propulsion Panel of the Air Force's Scientific Advisory Board.

Robert A. Trennert, former deputy chief for the USAF Air Research and Development Command Regional Office in Los Angeles, has been named manager of the Western sales region for Grand Central Rocket Co., Redlands, Calif.

The Columbus Division of
North American Aviation, Inc.

Offers the following immediate openings:

HYDRODYNAMICIST – To direct effort on design of advanced hydronautics vehicles and conduct research in related problem areas. Engineer with M.S. or PhD degree plus eight to ten years direct experience in hydrodynamic design and research.

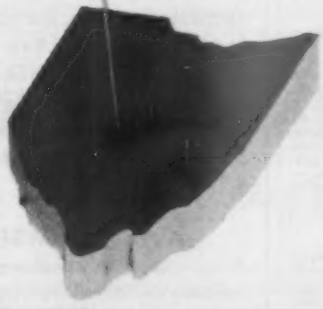
ROTARY WING AERODYNAMICIST – To contribute to the design of new V/STOL vehicles and related research. Engineer with B.S. degree plus four to five years direct experience in rotary wing stability and control design and test.

AERODYNAMICIST-LOADS – To direct effort leading to development of new and improved methods of predicting static and operating airloads to support flying qualities and structural designs. Engineer with M.S. degree plus eight to ten years direct experience in prediction of aerodynamic loads.

SERVO-DYNAMICIST – To establish dynamic flight requirements for advanced vehicles as influenced by autopilot/stability augmentation considerations. Engineer with B.S. degree plus six to eight years direct experience in dynamic stability and autopilot analysis.

THEORETICAL AERO-THERMODYNAMICIST – To direct research and development efforts in the aero-thermodynamics of hypersonic and rarefied flows and in the area of magneto-hydrodynamics. Engineer or scientist with M.S. or PhD degree plus six to eight years direct experience in theoretical fluid mechanics.

Please write to: H. Keever, Engineering Personnel Manager, North American Aviation, Inc., Columbus, Ohio.



THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Home of the T2J Buckeye and the A3J Vigilante

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work
Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered
Employment Agencies
Employment Services
Labor Bureaus

RATES

DISPLAYED

The advertising rate is $52.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising Inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

UNDISPLAYED

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted Ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

TO THE ENGINEER WHO CAN SELL . . .

This is for the man who can grasp the long range growth potential of a dynamic, young organization. Here is an unusual career opportunity with a fast growing, yet stable, company . . .

A company whose annual sales have grown to more than 10 Million in just nine years.

BSME or BSEE with 3 - 5 years of experience selling technical products. Aircraft, missile, controls, or machine tool experience desirable. Excellent salary and supplementary benefits.

The expanding field of electro-hydraulic servo-controls offers an unusual opportunity for you in an engineer-directed company. The advantages of small company atmosphere in a suburban Buffalo environment, the merits of profit sharing, and the prestige of industry leadership. Please submit complete resumes and salary requirements to . . .

MOOG SERVOCONTROLS, INC., East Aurora, New York

STEWARDESS

Prominent company with private plane seeks stewardess who is also capable stenographer. Excellent starting salary plus our Fee Neg.

FIDELITY PERSONNEL OF PHILADELPHIA
1530 Chestnut Street
Locust 8-6868

AIRCRAFT STRESS ANALYST

Minimum of four years experience in static and dynamic analysis of airframe structures.

AIRFRAME DESIGNER

Minimum of five years experience in design of airframe structures. B. S. degree in A. E. or equivalent. *Send resume to J. E. Padgett*

PARSONS CORPORATION
P. O. Box 112. Traverse City, Michigan

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Flight engineers wanted for part time industrial survey work in propulsion field throughout U. S. Send resume of powerplant experience to P-4571, Aviation Week.

Airline Operating Executive. Our company requires the services of an operating executive with five years or more experience in the air transportation industry. Legal training desirable. Residence Middle Atlantic area. Age to 35. Mail resume to P-4587, Aviation Week.

POSITIONS WANTED

Maintenance Supervisor with over 20 years experience, desires responsible position. Familiar with all phases including electronics and all twin engines types including 440. References and resume on request. PW-4498, Aviation Week.

Experienced director of aviation, present position 10 years. Interested in similar position with fleet operator. PW-4553, Aviation Week.

Engineer, BSAE, 6 yrs exp. industry & military liaison, fluent French, seeks long term European assignment in sales or technical liaison. PW-4563, Aviation Week.

Pilot or co-pilot mechanic, commercial ASMEL instrument A&E. Desires corporation or executive flying position. Resume on request. Maynard Kruger, 140 Charles St., Batavia, Ohio. Ulysses 2-3481.

POSITIONS WANTED

ATR ASEL with commercial AMEL 5000 hours seeking corporate copilot job in DC3 or Convair. Have had complete ground school both types. Desire eventual captaincy. 33, married, family, sober. PW-4608, Aviation Week.

Thoroughly experienced, temperate and reliable pilot with DC-3 type ATR, S&MEL&S, helicopter, glider, CFI A&I ratings, desires position as light twin pilot, or what have you? Military and American Flyers trained. Diversified background. Satisfaction guaranteed. Free trial period. Ray Miller, McGregor, Iowa, Tp 625.

SELLING OPPORTUNITIES WANTED

Representation. For suppliers of GSE and electronic and mechanical components to aircraft and missile manufacturers in the vital San Diego area. P. O. Box 367, Del Mar, Calif.

NEED EXPERIENCED ENGINEERS?

Place an "Engineers Wanted" advertisement in this EMPLOYMENT OPPORTUNITIES section. *It's an inexpensive, time saving method of selecting experienced personnel for every engineering job in the electronic industry.* The selective circulation of AVIATION WEEK offers you an opportunity to choose the best qualified men available throughout the industry.

For rates & information write

AVIATION WEEK
Classified Advertising
Post Office Box 12 New York 36, New York

Field Engineers

HOW'S THIS FOR RESPONSIBILITY?

Important projects are your daily concern as a Kearfott Field Engineer. You play a vital role in liaison, installing, testing, evaluating and modifying intricate airborne navigation and guidance systems . . . systems which frequently are unique, being tried and tested for the first time.

You're called on to make detailed recommendations to overcome complex problems puzzling to experts — because you're Kearfott's expert on the spot, knowing most about the system and how it operates.

You probe the insides of complex airborne computers, navigation and guidance, and associated ground support equipment. And you work with important customer personnel — high level scientists, engineers and executives.

Here is demanding, responsible work. It requires a high level of engineering know-how and judgment, plus good appearance and personality. Sound education and experience are essential. (BS degree in a technical field and from 3-5 years electronics experience.)

The salary is excellent, reflecting the job's duties and responsibilities. At expanding Kearfott, your own desires will decide whether you wish to remain and advance in the Customer Services and Parts Division, or use the wide experience you have gained to join exciting programs in other Kearfott divisions.

Openings start at Kearfott's home in Little Falls, New Jersey, with nation-wide assignments to follow later. You will enjoy all company fringe benefits, including educational programs, and will be paid full expenses for your first six months in the field. If all this sounds like the job for you, write in confidence to Paul Kull, Dept. 5-X.

KEARFOTT DIVISION
GENERAL PRECISION INC.

1150 McBride Avenue
Little Falls, New Jersey

Engineers — Are your interests oriented toward customer contact?

MARKETING CAREERS FOR ENGINEERS

in the Field of Missiles & Space Vehicles

The Missile and Space Vehicle Department of General Electric in Philadelphia has several openings for graduate engineers interested in sales and marketing careers leading to positions in top management. If you are sensitive to people and human situations, have engineering experience in weapon systems, and can direct the efforts of a proposal team, you can qualify for an advanced sales engineering position at MSVD. Six to ten years in design or analytical engineering are prerequisite.

Write in confidence to Mr. D. G. Curley, Dept. 64-WW, giving full details of your experience.

MISSILE AND SPACE VEHICLE DEPT.

GENERAL ELECTRIC

3198 Chestnut Street

Philadelphia, Pa.

---

electrical or mechanical engineers

INTERESTING DIVERSIFIED HIGH-LEVEL POSITIONS

Honeywell introduced the first successful autopilot of World War II—the C-1. Since then we have produced more flight control systems than any other company. Today we are engaged in producing the automatic flight control system and the rate stabilization control system for Project Mercury, the flight reference system for the Titan, the solid state autopilot for the F-104, and the adaptive autopilot which controls flight through aerodynamic surfaces and reaction nozzles for the X-15.

One result of our X-15 Adaptive Autopilot effort has been the creation of a permanent reaction control system and development section which has been assigned to our Components Design Department.

Because of our expansion in this area we now have openings for engineers with the following background and experience.

REACTION CONTROL SYSTEMS ENGINEERS

Requires background in missile propulsion systems analysis as it relates to reaction controls. Must be able to establish reaction control requirements by analysis of vehicle dynamics and have an understanding of propellant fuels and oxidizers for specific systems; handle heat transfer problems to optimize and compare several concepts for a given duty cycle; determine optimum over-all performance characteristics, thrust response with given inputs, and chamber pressure and oxidizer-fuel ratios for various nozzle heat sink designs; assist on all proposal efforts requiring propulsion system analysis.

REACTION CONTROL DEVELOPMENT ENGINEERS

Requires background in rocket engine design, specifically bipropellant type. Must be capable in valving design techniques for injection mixing, oxidizer to fuel ratio adjustment, positive shut-off and valve actuation methods, determining thrust at sea level and vacuum with various fuels and combustion chamber designs. Must have working knowledge of high temperature materials and materials compatible with exotic fuels and oxidizers; ability to determine the optimum configuration (nozzle, valves, torque motor, injectors, etc.) for given applications; ability to work with design and layout draftsmen, model makers, and evaluation engineers in following through with a design development.

If you are a qualified engineer, we would like to hear from you. Just drop a line including pertinent information on your background, interests, and accomplishments to Mr. James E. Burg, Dept. 6661, Honeywell Aeronautical Division, 1433 Stinson Blvd. N.E., Minneapolis 13, Minn.

Honeywell

Military Products Group

To explore professional opportunities in other Honeywell operations coast to coast, send your application in confidence to H. K. Eckstrom, Minneapolis 8, Minnesota.

INERTIAL SYSTEMS DEVELOPMENT

..... there are opportunities at Honeywell Aero for the engineer or scientist who is interested in participating in this growing field of technology. While specific inertial systems experience is desirable, you may also be qualified by your background and/or related experience for activities in the inertial systems development at this time. Specific openings include:

SYSTEMS ANALYST

Mathematician or engineer with strong background in vector analysis, operational calculus, matrix algebra and related techniques. To carry out analysis of inertial systems configurations including error evaluation.

DIGITAL SYSTEMS AND LOGIC DESIGNER

Familiar with digital logic techniques at current state of the art; capable of organizing computing systems to perform various tasks including logical design and critical parameter specification.

ELECTRONIC ENGINEER

Electrical engineering degree plus experience in miniaturized semiconductor electronics development. To design servo, pickoff, and other electronics for use with gyros and accelerometers.

ENGINEERING PHYSICIST

Physicist with practical and theoretical understanding of mechanics, magnetism and electricity to analyze and develop inertial sensors of novel and original design.

To discuss these or other openings, write Mr. R. O. Maze, Chief Engineer, Marine Systems Group, Dept. 666C, Aeronautical Division, 1433 Stinson Blvd., Minneapolis 13, Minn.

Honeywell

Military Products Group

To explore professional opportunities in other Honeywell operations coast to coast, send your application in confidence to H. K. Eckstrom, Honeywell, Minneapolis 8, Minnesota.

LENKURT

has opportunities for

- **Microwave Radio Design Engineers**
- **Telephone Carrier Development Engineers**
- **Sales Engineers**

  Extensive telephone experience required. BSEE also required.
- **Engineering Writers**
- **Quality Control Engineers**

THE CHALLENGE . . .

Unlimited opportunity for continued growth in a growing company . . . in the ever-expanding field of Communications!

THE LOCALE . . .

The ULTIMATE in Stateside locations: Beautiful San Carlos, located in the center of West Coast Electronic Research and Development. San Francisco is just minutes away. Excellent housing, schools, colleges . . . diversified year 'round recreation in the United States' most perfect climate!

Direct inquiries to:

E. Jack Shannahan
Employment Manager

LENKURT
ELECTRIC COMPANY, Inc.
1105 County Rd., San Carlos, Calif.
If more convenient, call—collect—LYtel 1-8461

NEED ENGINEERS?

An employment advertisement in the EMPLOYMENT OPPORTUNITIES SECTION will help you find the engineers you need. It's an inexpensive, time-saving method of contacting competent personnel for every engineering job in the Aviation industry. The all paid circulation of AVIATION WEEK offers you an opportunity to choose the best qualified men available.

For rates and information write:

•

Classified Advertising Division

AVIATION WEEK

P. O. Box 12 New York 36, N. Y.

MILITARY SALES ENGINEERS

In our expanding work of research, development, design and manufacture of electronic and electromechanical systems for all branches of the armed forces, we are enlarging our present sales organization. Our program will require several sales engineers with approximately five years military sales experience and familiarity with research and development requirements of the military services.

Special consideration will be given to applicants with experience in Inertial Guidance, Fuzing and Arming, Reconnaissance, and Special Purpose Analog and Digital Computers. Salary will be commensurate with previous experience in these types of government contracts. Travel required. At this time we are considering candidates for direct sales engineering as our managerial positions are filled by promotions.

Replies in strictest confidence. Please mail complete resume or letter of application stating your salary expectations to Mr. P. F. McCaffrey.

FORD INSTRUMENT COMPANY

Division of Sperry Rand Corporation

31-10 THOMSON AVENUE
LONG ISLAND CITY 1, NY

TOP LEVEL ANALYTICAL ENGINEERS

NEEDED IMMEDIATELY TO FILL KEY POSITIONS IN EXPANDING ORGANIZATION

Minimum requirements Masters Degree plus 3 years experience in one of the following specialties:

HYPERSONIC AERODYNAMICS
Real Gas Flow, Plasma Flow, Low Density Flow and Physics of the Atmosphere

ADVANCED PROPULSION SYSTEMS
Plasma Jet and Nuclear Propulsion

FLIGHT MECHANICS
Re-entry, Orbital and Space

DYNAMIC AEROELASTICITY
Dynamic Response of Flexible Vehicles-Application of Advanced Aeroelasticity and Flight Control Techniques to Flight Dynamics of Flexible Vehicles

DYNAMIC AEROELASTICITY
Advanced Analog Simulations for Flexible Automatically Controlled Aero-Space Vehicle Systems

SYSTEM DYNAMICS
Guidance System Analysis General Flight Mechanics, Closed Loop System Analysis

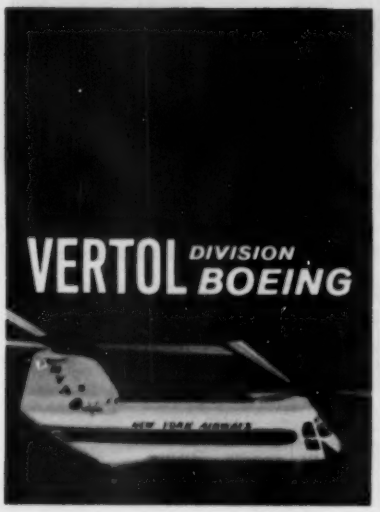
GUIDANCE AND CONTROL SYSTEM ANALYSIS FOR SPACE VEHICLES

ANALOG & DIGITAL COMPUTATION
Statistical Analysis and Design Methods for Automatic Control Systems

DESIGN & DEVELOPMENT OF HOT STRUCTURES

Direct replies in confidence to:
DR. WALTER DORNBERGER
Director of Engineering
BELL AIRCRAFT CORPORATION
P. O. Box 1, Buffalo 5, New York

ENGINEERS:



Commercial expansion, evidenced by an initial order for the Vertol 107 Model II from New York Airways . . . increased activity in military VTOL/STOL aircraft . . . plus existing military commitments for the Chinook—combine to offer exceptional opportunities for graduate engineers, in the following areas:

APPLIED ACOUSTICS

Assignments range from measurement of data through design of acoustic treatments for aircraft, including noise reduction research programs. 2-5 years' experience.

AERODYNAMICS

2-4 years' experience.
VTOL/STOL preferred.

ELECTRICAL

Senior level. Minimum 5 years' aircraft electrical system design experience.

FLIGHT TEST INSTRUMENTATION

Minimum 1 year's experience.

FLIGHT TEST PLANNING

Minimum 1 year's experience.

Call Kingswood 3-4000,
write or forward your resume in complete confidence to:

M. Adelberg
Supervisor of Personnel Relations

VERTOL DIVISION BOEING
NORTON PENNSYLVANIA

OPPORTUNITY

the most over-advertised ingredient in the engineering employment picture . . . a thing you recognize the lack of *after* you've been on the job awhile. But at Texas Instruments Incorporated it's in the very air you breathe, as any broker can *show* you.

Metals & Controls — TI's newest division — has immediate openings for Research Engineers, Manufacturing Engineers, Sales Engineers and Product Development Engineers.

TI's liberal employee benefits include profit-sharing, semi-annual performance reviews, educational assistance, and relocation expenses. Excellent starting salaries; but the real bargain is the opportunity.

Write or phone Mr. Andrew Staley, Dept. 32, for further information.

TEXAS INSTRUMENTS
INCORPORATED
METALS & CONTROLS DIVISION
34 FOREST STREET • ATTLEBORO, MASS., U.S.A.

"Put Yourself in the Other Fellow's Place"

TO EMPLOYERS

TO EMPLOYEES

Letters written offering Employment or applying for same are written with the hope of satisfying a current need. An answer, regardless of whether it is favorable or not, is usually expected.

MR. EMPLOYER, won't you remove the mystery about the status of an employee's application by acknowledging all applicants and not just the promising candidates.

MR. EMPLOYEE you, too, can help by acknowledging applications and job offers. This would encourage more companies to answer position wanted ads in this section.

We make this suggestion in a spirit of helpful cooperation between employers and employees.

This section will be the more useful to all as a result of this consideration.

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., INC.
330 West 42nd St., New York 36, N. Y.

CAREER OPPORTUNITIES
with BAUSCH & LOMB

Section Head, Mechanical Engineering
3 to 6 years experience in military products, including design.

Project Director, Mechanical or Electrical Engineering (M.S. or Ph.D)
Servo and machine tool design, for grid and scale ruling project.

Mechanical Engineers
- Senior Designer, experienced in creative fields of mechanisms, kinematics, machine design.
- B.S. in mechanical design, with strong background in physics
- Five years experience in creative design of instruments or mechanisms.

Procurement Engineer
For military products organization—purchase of electronic, mechanical and optical components to military specifications. Must be familiar with subcontracting procedures.

Sales Engineers
For military products organization. B.S. in engineering or equivalent; 3 to 4 years sales experience. Knowledge of electronics, mechanisms, optics helpful. Locations: Washington, D. C., and Dayton, Ohio.

Reply, with resume, to
Mr. Ellis P. Fare, Employment Manager,
BAUSCH & LOMB,
635 St. Paul St., Rochester 2, N. Y.

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 8 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

ANTENNA PEDESTAL SCR 584—MP 61B

Full azimuth and elevation sweeps. 360 degrees in azimuth. 210 degrees in elevation. Accurate to 1 mil, or better over system. Complete for full tracking response. Angle acceleration rate: AZ. 9 degrees per second squared EL.4 degrees per second squared. Angle slewing rate: AZ 20 degrees per sec. EL. 10 degrees per sec. Angle tracking rate: 10 degrees per sec. Includes pedestal drives, selsyns, potentiometers, drive motors, control amplidynes. Excellent condition. Quantity in stock for immediate shipment. Ideal for missile & satellite tracking, antenna pattern ranges, radar systems, radio astronomy, any project requiring accurate response in elevation and azimuth.
Complete description in McGraw-Hill Radiation Laboratory Series, Volume 1, page 284 and page 209, and Volume 26, page 233.

RADIO RESEARCH INSTRUMENT CO.
550 FIFTH AVE.
NEW YORK
JUDSON 6-4691

GROWING AIRLINE

INTERESTED IN

FOUR ENGINE AIRCRAFT

WITH LOW TIME SINCE OVERHAUL
CARGO/PASSENGER CONFIGURATION

LONG TERMS WITH GOOD BANK GUARANTEE REQUESTED

P. O. BOX 2299
BARRANQUILLA /COLOMBIA

WANTED twin engine aircraft

OUR TERMS-CASH

We are not brokers

GRAUBART AVIATION, INC.
Mohawk 4-6260
PRUDENTIAL PLAZA CHICAGO, ILL.

IDEAS, PATENTS WANTED

We are seeking patented or patentable items for manufacture and sale to the Civilian Aviation Market. We can consider only those items which are useable on many or all types of business and private aircraft, and which will contribute to safety, comfort and economy of flying.

If you wish to negotiate an arrangement for the manufacture and sale of such a potential product, please send information with pictures or drawings to our New Products Department, via Registered Mail.

SCOTT AVIATION CORPORATION
Lancaster, New York

FBA

CONVAIRS·DOUGLAS DC-6's

Limited quantity Convairs in executive or airline configurations and DC6/6A/6Bs. Prompt delivery at best prices. Long or short term lease, trade-ins and financing available at terms that cannot be duplicated.

Frederick B. Ayer & Associates
World-wide Aircraft Center
250 Park Avenue, New York, N. Y.
MU 7-1800

DC-3

28 Passenger Interior
P & W 1830 Engines
Former Airline Airplane

Write—Wire—Phone

CENTRAL AIRCRAFT Corp
P O Box 48-126
MIAMI, FLA.
Tel. - NE 4-1171 - Wire - FAX

FOR SALE

N335V LOCKHEED T-33A JET

DUAL CONTROLS

Clear title, excellent chase plane, high speed test bed, route survey or jet transition trainer. Sale or lease. All types trades accepted. Deal direct with owner.

E. D. WEINER
8760 Sherbourne Drive, Los Angeles 46, Calif.
Phone OLympia 2-1802—24 hours

For Sale or Lease

SIKORSKY S-55 HELICOPTERS

Fleet of 5 available with spares.
Trades accepted.
STINSON FIELD AIRCRAFT
BOX 1738, San Antonio, Texas CA 4-8434

FOR SALE

2 DC6AB Aircraft

Passenger/Cargo Combination
UNITED STATES OVERSEAS AIRLINES
Cape May County Airport
P. O. Box 234 Wildwood, New Jersey

OXYGEN EQUIPMENT

SALES & SERVICE
REGULATORS — MASKS — VALVES
PORTABLES & CYLINDERS
FIXED INSTALLATIONS
GOV'T. APPROVED REPAIR STATION

ZEP AERO Phone: ORegon 8-1161 EL SEGUNDO, CALIFORNIA

CONVAIR 240

2800 CB-16. Will trade, finance or lease. Also available: large selection of trade-ins—DC-3's, Lodesters, C54-E's etc.
Priced to sell!
CALIFORNIA AIRMOTIVE CORP. Dept. AW
7139 Vineland Ave., No. Hollywood, Cal. TR 7-1564

FOR SALE

PBY 5A. Two amphibians converted for 2 crew—cargo—passenger use. FS-3404, Aviation Week.

1958 Bell Helicopter 47G2, fully equipped, ready to fly. TT620. 600 inspection done. Blades factory reconditioned. J-W Helicopters, Arcata, Airport, Calif. TE-9-2216.

DC3 1820-56 executive interior. 16 place extra gas. Airstair door. Collins radios. A first class airplane. Consider light twin in trade. Price $135,000. Phone MI 4-5366, Reg Robbins, Municipal Airport, Houston, Texas.

Widgeon 44 A Lycoming 260 HP Lockheed conversion hartzel three blade props. Reclining seats good radio, perfect condition $42,500. Reg Robbins MI 4-5366, Municipal Airport, Houston, Texas.

BOOKS

Fairchild PT-19 series, PT-23, & PT-26 Airplane Flight Handbook available now. Special U. S. Government authorized re-issue. T. O. No. 01-115GA-1; final revision August 5, 1944. Only $8.15/copy including fine, handsomely printed binder. C.O.D. orders welcome. Write: Military Aircraft Surplus, Technical Publications Service, PO Box 90032, Los Angeles 45, California.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JUNE 13, 1960

AEROJET GENERAL CORP. ..... 2nd Cover
AEROQUIP CORP., MARMAN DIVISION 9
AIRBORNE ACCESSORIES CORP. 6
ALUMINUM CO. OF AMERICA, MISSILES, AVIATION ORDNANCE 36
AMP INCORPORATED 86
ARMSTRONG-WHITWORTH AIRCRAFT LTD. 46
AVCO CORPORATION ..... 4th Cover

BECKMAN INSTRUMENTS, INC. 58, 93
BELL HELICOPTER CORP. 8
BENDIX PACIFIC DIVISION, BENDIX CORP. 82
BENDIX SYSTEMS DIVISION, BENDIX CORP. 56
BUDD COMPANY, THE 78

CANADIAN MARCONI COMPANY 35
CESSNA AIRCRAFT COMPANY 77, 120
CHANCE VOUGHT AIRCRAFT, INC. 94, 126
CLIFTON PRECISION PRODUCTS CO., INC. 3rd Cover
COLUMBUS DIVISION, NORTH AMERICAN AVIATION INC. 14, 127
CONTINENTAL-ENSCO CO. 84
CONVAIR DIV. GENERAL DYNAMICS CORP. 133
CRAIG SYSTEMS, INC. 124

DECKER CORPORATION 16
DOUGLAS AIRCRAFT CO., INC. 80-81

FAIRCHILD ENGINE & AIRPLANE CORP. 44
FOOD MACHINERY AND CHEMICAL CORP. 90-91

GARRETT CORP., THE 12
GENERAL ELECTRIC CO. 15
GIANNINI CONTROLS CORP. 92
B. F. GOODRICH CO., THE 22

HAMILTON STANDARD DIV. UNITED AIRCRAFT CORP. 62-63
HARNISCHFEGER CORP. 13
HAWKER SIDDELEY LTD. 72
HEXCEL PRODUCTS, INC. 10
HORKEY-MOORE ASSOCIATES 108
HYDRO AIRE COMPANY 3

INTERNATIONAL BUSINESS MACHINES CORP. 123
INTERNATIONAL ELECTRONIC RESEARCH CORP. 99

KAMAN AIRCRAFT CORP. 118
KINETICS CORPORATION 101

LIBRASCOPE DIVISION, GENERAL PRECISION INC. 24
LITTON INDUSTRIES, ELECTRON TUBE DIV. 60
LITTON INDUSTRIES 124
LOCKHEED AIRCRAFT CORP. 20
LORD MANUFACTURING CO. 65

MARTIN COMPANY, THE DENVER DIVISION 102
MICRO SWITCH DIVISION, MINNEAPOLIS REGULATOR CO. 106-107
MILLER ELECTRIC MFG. CO., INC. 122
MINNEAPOLIS HONEYWELL REGULATOR COMPANY 66-71
MOTOROLA, INC., MILITARY ELECTRONICS DIV. 114-115

NICHOLS CO., W. H. 61

PORTER CO., J. K., INC., THERMOID DIV. 98
PRATT & WHITNEY DIV., UNITED AIRCRAFT CORP. 42
PYRODYNE INC. 100

RADIATION, INC. 74
REMINGTON RAND UNIVAC DIV. SPERRY RAND CORP. 11
RESISTOFLEX CORP. 77
ROHM & HAAS CO. 116-117
ROHR AIRCRAFT CORP. 53
RYAN AERONAUTICAL CO. 96-97, 125

SARGENT ENGINEERING CORP. 4
SCOTT AVIATION CORP. 117
SERVOMECHANISMS, INC. 5
SIKORSKY AIRCRAFT DIV. UNITED AIRCRAFT CORP. 59
SPERRY GYROSCOPE CO., DIV. SPERRY RAND CORP. 17
STILLMAN RUBBER CO. 108
STROMBERG-CARLSON ELECTRONICS 99

TEXAS INSTRUMENTS, INCORPORATED 88
THOMPSON-RAMO-WOOLDRIDGE, INC. 7
THOMPSON-RAMO-WOOLDRIDGE, INC., TAPCO GROUP 110-111

VICKERS, INC., DIV. SPERRY RAND CORP. 18
VICKERS ARMSTRONG LTD. 50-51

WHITNEY METAL TOOL CO. 100

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 128-131

EQUIPMENT (Used or Surplus New) For Sale 132

ADVERTISERS INDEX

Ayer & Assoc., Inc., Frederick B. 132

Bausch & Lomb 131
Bell Aircraft Corporation 130

California Airmotive Corp. 132
Central Aircraft Corporation 132

Fidelity Personnel of Philadelphia 128
Ford Instrument Co. Div., Sperry Rand Corporation 130

General Electric Company 129
Graubart Aviation, Inc. 132

Kearfott Div., General Precision, Inc. 128

Lenkurt Electric Co., Inc. 130

Minneapolis-Honeywell Reg. Co. 129-130
Moog Servocontrols, Inc. 128

Parsons Corporation, Aircraft Division 128

Radio Research Instrument Company 132

Scott Aviation Corporation 132
Stinson Field Aircraft 132

Texas Instruments Incorporated 136

United States Overseas Airlines 132

Vertol Aircraft 131

Weiner, E. D. 132

Zep Aero 132

ELECTRONIC FIELD TEST ENGINEERS

Versatile, practical-minded engineers with a record of accomplishment in the missile, aircraft or related fields will now qualify for a field test position at Convair-Astronautics — creators and testers of the mighty ATLAS ICBM. Positions must be filled immediately at various locations, from Cape Canaveral, Florida to Vandenberg AFB near Santa Maria, California. Field test operations are in two major groups: ACTIVATION—coordination of construction and the integration of support systems with facilities; and OPERATIONS—the preparation, checkout and launching of the missile itself. Specific requirements are in R. F. communications, instrumentation, missile control and guidance systems.

Write now to R. B. Merwin, Engineering Personnel Administrator, Department 130-90

CONVAIR ASTRONAUTICS

Convair Division of

GENERAL DYNAMICS

5508 Kearny Villa Road, San Diego, California

LETTERS

True Deterrence

In reading the letter by Mr. Roth (AW May 23, p. 124) it is not hard to see that it was indeed a "reckless intruding into the verbal slugfest." There can be no doubt that because one doubts he thinks, but this does not ensure correct thinking.

An analysis of Soviet strategy will show that they are willing to suffer devastating damage to their cities and home land if they can be assured of the survival of their system in some other locale, namely Western Europe. The use of our missiles to strike these targets would, in this light, provide a very poor deterrent. The uselessness of hardening our missile sites does not lend itself to self preservation. Since it is our national policy to avoid aggression we must, therefore, provide some means of ensuring our survival of a nuclear attack. Perhaps Mr. Roth does not expect us to survive a first blow by the Soviets, even with hardened sites?

The true nature of a deterrent force is that force which causes the enemy to withhold from attacking us for fear of receiving an unacceptable amount of damage to its over-all governmental system and national resources. For this reason we do not need sufficient missiles to enable us to completely eliminate the enemy's attacking force. We need only a sufficient "mixed force" to prevent the enemy from attacking. We do not need, therefore, 1,500 missiles to provide an adequate deterrent.

We must not rely totally upon missiles, however, for they have many faults that are easily solved by the use of manned aircraft. (This is not to say that we should do away with all missiles.) The inability to recall a missile is perhaps its most noticeable fault. The increasing error with range is another. Manned aircraft are, therefore, a necessity. We must also avoid obsolescence in our force. If, as Mr. Roth says, the B-70 will be insufficient for our needs, then surely the B-47, B-52 and the B-58 are also, if not more so, useless. We must remain abreast of scientific advances and procure the best equipment available. For us, this is the B-70. True, it is expensive, but then what other weapon in our inventory is not?

Mr. Roth states that he is unable to see the direction of our procurement policies. He is unable to fathom whether we are concentrating upon deterrence or pre-emptive war. Thought on this matter would readily produce the conclusion that the threat of a pre-emptive war also constitutes a deterrence. He also seems to think that we are spending outrageous sums for the survival of our national integrity (including his own life). When one considers that the U. S. spends approximately 18% of its gross national product on defense while the Soviet Union annually contributes about 54%, then perhaps we are not spending quite as much as originally thought.

As to the protection of our society, how can the military protect a people who apparently do not want to be protected? There have been numerous attempts to provide public financing for shelters. All have been vetoed! If one has ever been in a large city during an air raid drill, he would view the apparent lack of interest of the populace to take any heed of the drill. If our deterrent should fail, then we will have to rely upon our home land air defense to protect us. Should we, therefore, not only protect the vital portions of our air defense (SAGE, NORAD HQ) but also strengthen them? For myself, I do not consider our air defense as "nonsense" as does Mr. Roth.

It is hard for me to see how our defense spending has been "bleeding our economy" when our national income rises year after year, when our per capita income rises year after year, and the total investment in this country is constantly increasing. The Soviet Union is willing to forego some of the luxury items for consumption by the public to try and preserve and extend its system. Should the United States, if it values democracy so much, be willing also to spend less than 60% of its GNP on consumer purchases? Perhaps we would be in a better situation if the military minds of the country, in the body of the Joint Chiefs of Staff, were allowed to decide how the allotted monies were to be spent instead of the political minds of the nation.

In reality then, it is not a question of how much we are spending on defense, but rather how we are spending what we do spend. To paraphrase a prominent congressman—if we purchase an item and it lasts for only one year, yet prevents war, then it was a necessary expenditure. Perhaps Mr. Roth should put more thought into this subject and examine a few authorities before further "reckless intruding" into the manner of our nation's defense.

(Name withheld by request.)

CADET, USAF ACADEMY
Colorado Springs, Colo.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Radiation Weapon

I read the brief report entitled "Anti-ICBM Ray Research" (AW Apr. 11, p. 31) with considerable interest. Two and a half years have passed since my letter concerning a radiation weapon appeared in your pages (AW Nov. 25, 1957, p. 126) and a new situation has evolved. A device that seemed fantastic and absurd two and a half years ago is now deemed worthy of development. My own spare-time studies lead me to agree with Dr. Charyk that technical uncertainties still exist, but the successful development of a radiation weapon is not in doubt.

The development of a radiation weapon, such as a transmutation beam, will be shaped by the strategy and tactics governing the use of the weapon. Therefore, the planning of basic strategy and tactics should proceed concurrently with the preliminary synthesis of weapon configuration. In particular, the question of ground-based versus space-based radiation beams must be decided quickly. It is my opinion that the use of ground-based radiation weapons will be ultimately futile and that only by placing these weapons in a space environment can we create a truly effective defense against A-bombs and H-bombs.

If the Russians become the first to operate manned satellites (and everything, including the leisurely pace of our own space program, points to this), it seems likely that they will establish a space monopoly by seizing or destroying any manned satellite we put into orbit. Space will be an ideal environment for the use of radiation weapons, and it is not probable that the Russians will share a position of such great advantage with us. The Russian launching on May 15 of an instrumented version of a manned satellite is another warning that we may soon be barred from space.

Space superiority will be as vital in the next two decades as was air superiority in the past 20 years, and those who ridicule space flight as useless and wasteful are condemning the United States to a fate more terrible than that of Hiroshima.

There is an element of this situation as disturbing as the probability of a Russian monopoly of space flight . . . the loss of time between the moment when a radiation weapon became theoretically possible and the moment when serious study of this possibility was begun. From my own experience I can state that the possibility of a radiation weapon was apparent in the summer of 1955. Furthermore, although hampered by a lack of time and a lack of much public information easily available to scientists, I had developed a basic conception of a transmutation beam by the fall of 1956. Yet, as far as I can tell, no government body examined the possibility of a radiation weapon until 1958, and study contracts were not awarded until the spring of 1959 (the CLIPAR program, AW Mar. 2, 1959, p. 18). Certainly talent and data were not lacking; the loss of two to three years seems inexplicable.

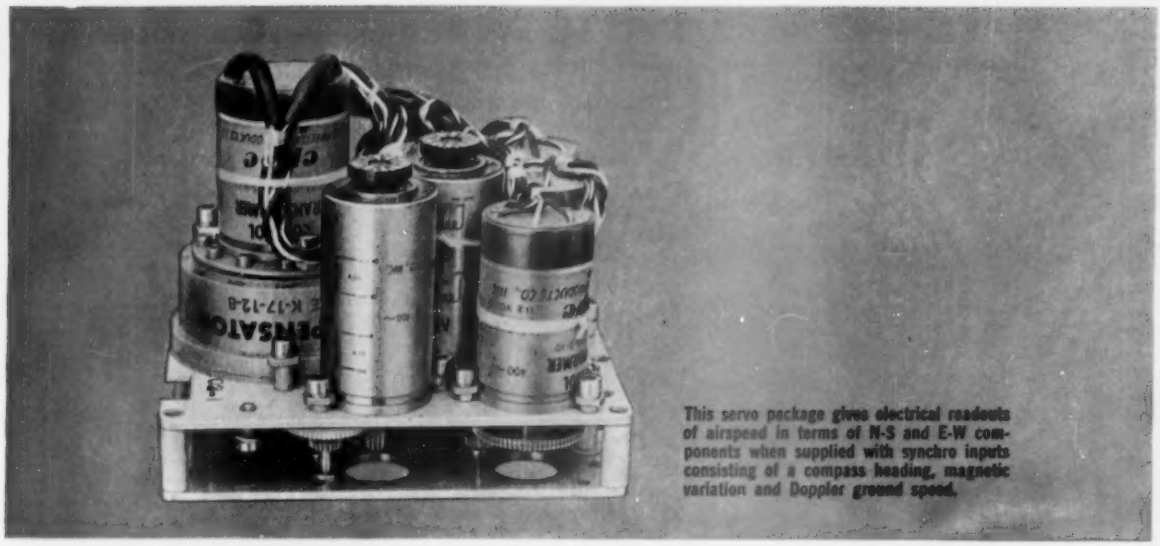
If there is some inherent defect in the present organization of national defense that causes prolonged delay, that defect must be corrected at once. We have no time to lose.

ALFRED MACHADO, JR.
New Bedford, Mass.

Gulliver's Travels

Your photo story on a closed waste recycling system (AW Apr. 25, p. 81) brings to mind Gulliver's visit to the Grand Academy of Lagado, on his voyage to Laputa, circa the year 1707. Here he met a venerable savant who, for many years, had been engaged in the selfsame task that Dr. Chapman is now working on. Let us wish the Doctor more success than Dean Swift attributed to his 18th century scientist.

THOMAS B. FRIEDMAN
Pacific Palisades, Calif.



This servo package gives electrical readouts of airspeed in terms of N-S and E-W components when supplied with synchro inputs consisting of a compass heading, magnetic variation and Doppler ground speed.

NOW BUY cppc QUALITY ACCURACY RELIABILITY

IN cppc SERVO MODULES

In designing and producing servo modules to *your* specifications, Clifton Precision Products Co. manufactures 95% of the parts used. What does this mean to you? It means that the same high accuracy, reliability, and quality which go into the manufacture of CPPC synchros are maintained in CPPC Systems. This one source responsibility gives you the added advantage of a continuous Quality Control activity which guarantees a high quality product.

CPPC has had years of broad experience in researching, designing, developing, and manufacturing a wide variety of servo packages. A few examples of our products are shown on this page. Here at your service is a first class engineering design and manufacturing team from research through production.

Write for a more detailed facilities brochure or telephone Ken McGrath, Sales Department, HIlltop 9-1200 or our Representatives.

cppc
SYSTEMS DIVISION

CLIFTON PRECISION PRODUCTS CO., INC.

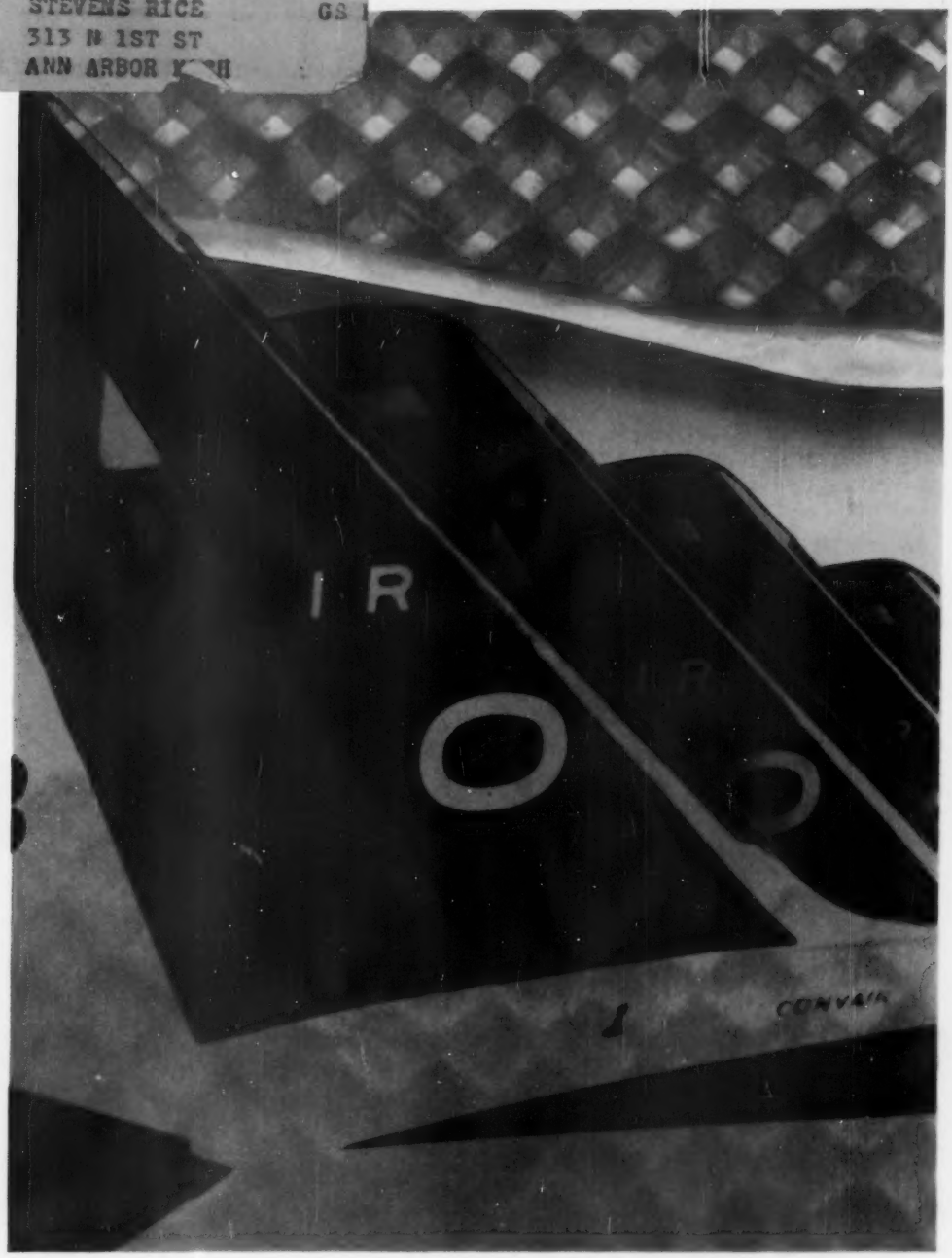
Clifton Heights Pennsylvania

This "Synchronizer Drive" servo package is used to null out gyro signals before an aircraft's autopilot is engaged.

This "Synchronizer Drive" can be used to null out transmitter signals. A wide variety of gear ratios is available as well as the option of two speed operation.

This transducer servo package converts a mechanical shaft input into a linear precise electrical output when a 28v dc signal is applied. It is particularly useful in aircraft for position information transmission of air surface controls.

UNIVERSITY MICROFILM IN
STEVENS RICE GS
313 N 1ST ST
ANN ARBOR



Honeycomb fins for the Convair 880. The sleek new 880 has many important components produced by Avco, and employing its Avcomb structural materials. Contributions include the incredibly strong vertical and horizontal stabilizers, rudder, elevators, wing tips and wing leading and trailing edges. These lightweight components are only the latest examples of Avco/Nashville's vast reservoir of experience and production capability in advanced aircraft structures. Avco's Nashville Division will also produce important structures for the newer Convair 600.

UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS... WRITE AVCO TODAY.

Avco

AVCO CORPORATION, 750 THIRD AVENUE, NEW YORK 17, NEW YORK